

L-Trp to the C-FM diet resulted in similar growth performance and carcass traits as barrows fed the C-SBM diet ( $P > 0.10$ ). In Exp. 2, 60 barrows (initial and final BW of 74.6 and 104.5 kg, respectively) were used to estimate the dTrp requirement. The levels of dTrp used in Exp. 2 were 0.06, 0.08, 0.10, 0.12, or 0.14%. Response variables were growth performance, PUN concentrations, carcass traits, and pork quality. The dTrp requirement was estimated to be 0.102%. In Exp. 3, 4, and 5, barrows ( $n = 60, 60, \text{ or } 80$ , respectively) were allotted to five dietary treatments supplemented with crystalline L-Trp, and PUN concentration was the response variable. The levels of dTrp in Exp. 3 (BW was 30.9 kg) were 0.13, 0.15, 0.17, 0.19, or 0.21%. The dTrp requirement was estimated to be 0.167%. The levels of dTrp in Exp 4 (BW was 51.3 kg) were 0.09, 0.11, 0.13, 0.15, or 0.17%. The dTrp requirement was estimated to be 0.134%. The levels of dTrp in Exp. 5 (BW was 69.4 kg) were 0.07, 0.09, 0.11, 0.13, or 0.15%. The dTrp requirement was estimated to be 0.096%. These data indicate that the dTrp requirements of barrows weighing 30.9, 51.3, 69.4, and 74.6 to 104.5 are 0.167, 0.134, 0.096, and 0.102%, respectively.

**Key Words:** Barrows, Requirement, Tryptophan

**581 The isoleucine requirement of 80- to 120-kilogram barrows.** D. W. Dean<sup>\*1</sup>, L. L. Southern<sup>1</sup>, B. J. Kerr<sup>2</sup>, and T. D. Bidner<sup>1</sup>, <sup>1</sup>LSU Agricultural Center, Baton Rouge, LA, <sup>2</sup>USDA-ARS-MWA-SOMMRU, Ames, IA.

Three experiments were conducted to validate an Ile deficient diet and then to determine the Ile requirement of 80- to 120-kg barrows. Cross-bred barrows ( $n = 60, 80, \text{ or } 80$  with initial BW of 93, 82, and 85 kg, respectively) were used in each experiment. In Exp. 1, five replications with four pigs per pen were fed diets containing either a corn-soybean meal diet (C-SBM) or a corn-based diet containing 5% blood cells (BC) with or without 0.26% supplemental Ile (C-BC+Ile or C-BC) in a 28-d growth assay. On d 14, pigs receiving the C-BC diet were taken off experiment due to a severe depression in feed intake. Growth performance was not different for pigs fed C-SBM or C-BC+Ile ( $P = 0.36$ ) over the 28-d experiment. In Exp. 2, four replications with four pigs per pen were fed the C-BC diet containing 0.24, 0.26, 0.28, 0.30, or 0.32% true digestible (TD) Ile. The experiment lasted 7 d and was an attempt to estimate the Ile requirement using plasma urea nitrogen (PUN) as the response variable. Because of dramatic incremental increases in ADFI as TD Ile was increased, PUN could not be used to estimate the Ile requirement. In Exp. 3, five replications with four pigs per pen were fed the C-BC diet containing 0.28, 0.30, 0.32, 0.34, or 0.36% TD Ile. Three pigs per pen were slaughtered on d 33 or 61 for determination of carcass lean and fat measurements (117.8 kg average final BW). Daily gain, ADFI, and gain:feed were increased linearly ( $P = 0.007$ ) as Ile was increased in the diet. There were no effects of TD Ile level on 10th rib fat depth or loin muscle area; however, kilograms of lean was increased linearly ( $P < .001$ ) as TD Ile level increased. In summary, the Ile deficiency of a C-BC diet can be corrected by the addition of supplemental Ile, and the PUN method is not suitable when assessing Ile requirement due to dramatic changes in ADFI. The TD Ile requirement for 80- to 120-kg barrows for maximizing feed intake, growth, and kilograms of lean is not less than 0.36%.

**Key Words:** Isoleucine, Pig, Plasma Urea Nitrogen

**582 Determination of the optimum threonine:lysine ratio for prolific lactating sows.** A. M. Gaines<sup>\*1</sup>, N. H. Williams<sup>2</sup>, M. E. Johnston<sup>3</sup>, C. Zier<sup>2</sup>, G. L. Allee<sup>1</sup>, J. L. Usry<sup>4</sup>, and R. D. Boyd<sup>3</sup>, <sup>1</sup>University of Missouri, Columbia, <sup>2</sup>Pig Improvement Company, Franklin, KY, <sup>3</sup>The Hanor Company, Inc., Franklin, KY, <sup>4</sup>Ajinomoto Heartland LLC, Chicago, IL.

This study was conducted to determine the optimum threonine:lysine ratio for prolific lactating sows. A total of 269 PIC product sows (parities

1-6) were allocated by parity to four dietary threonine concentrations, 0.51, 0.58, 0.64, and 0.70%. Diets were formulated to contain 0.90% total lysine which, based on expected litter growth rate (2.35 kg/d), would have been below requirement. The four concentrations of threonine corresponded to total threonine:lysine ratios of 0.57, 0.64, 0.71, and 0.78, respectively. Experimental diets were corn-soybean meal based diets and contained 0.29% L-lysine-HCl. Soybean meal was held constant and dietary threonine was increased by adding L-threonine with additional synthetic amino acids supplied as necessary to meet the minimum amino acid profile. Sows were fed ad libitum from d 112 of gestation through a 19 d lactation period. Litter size was standardized by 24 h post-farrowing (avg. 11.5 pigs/litter). There was no treatment difference ( $P > 0.41$ ) in sow feed intake (avg. 6.3 kg/d). Sow weight loss during lactation ranged from 11.4-17.5 kg and was not affected by threonine:lysine ratio ( $P > 0.15$ ). Increasing the threonine:lysine ratio improved litter weight gain (quadratic,  $P < 0.06$ ), litter weaning weight ( $P < 0.05$ ), and the number of pigs weaned (quadratic,  $P < 0.06$ ). The highest threonine:lysine ratio (0.78) was detrimental to both piglet livability (88.6 vs. 91.2%) and litter growth rate (2.10 vs. 2.34 kg/d). A threonine:lysine ratio of 0.64 appears to optimize milk production and pigs weaned for high producing lactating sows nursing large litters. This estimate was the same for both younger (parity 1-2) and older sows (parity 3-6).

**Key Words:** Threonine, Lactation, Sows

**583 The valine requirement of lactating sows.** M. Etienne<sup>\*1</sup>, J. Y. Dourmad<sup>1</sup>, J. Noblet<sup>1</sup>, L. Le Bellego<sup>2</sup>, and C. Relandeau<sup>2</sup>, <sup>1</sup>INRA-UMRVP, Saint-Gilles, France, <sup>2</sup>Ajinomoto Eurolysine sas, Paris, France.

This study was undertaken to determine the effects of the valine:lysine ratio in the lactation diet on sow and piglet performance, milk and piglet compositions, and nitrogen balance of sows. A basal diet with barley, wheat, peas and soybean meal containing 135 g/kg CP was fortified with crystalline amino acids to reach an optimal balance between essential amino acids except for valine. The lysine level was limiting (7.6 g/kg), and crystalline L-valine was added so that the valine:lysine ratio was below (0.70, diet L), met (0.89, diet M) or exceeded (1.28, diet H) estimated requirements (INRA, 1991). Twelve replicates of three Landrace x Large White sows (mean parity, 2.5) were fed the experimental diets during a 25-d lactation. Litters were equalized to 13.7 piglets after farrowing. They did not have access to creep feed. Sow feed intake increased progressively up to 6 kg/d within 5 d and then remained constant. Feces and urine of sows were collected from 5 to 25 d of lactation. Body composition of two piglets/litter sacrificed at weaning was determined. Weight and backfat depth losses during lactation (26.7 kg and 2.8 mm, respectively) did not differ between groups. The mean number of piglets nursed (12.6) or weaned (12.1) was not affected by treatments. Mean piglet (6.47 kg) and litter weight at weaning (78.3 kg) and average daily gain of piglets (194 g/d) and litters (2.29 kg/d) were similar in the three groups. No significant effect of diet was found on milk composition determined at 5, 15 and 25 d of lactation. Mean dry matter, nitrogen, and energy output in milk estimated through growth rate and composition of body weight gain of the piglets were also unaffected (1.53 kg, 63.6 g, and 41.9 MJ/d, respectively). Piglets in the L group had more dry matter and fat and less nitrogen ( $P < 0.05$ ) in their body than those in groups M and H. The N retention coefficient in sows did not differ between groups. It is concluded that there is no advantage to increase the valine:lysine ratio in the lactation diet of sows beyond 0.90.

**Key Words:** Sows, Valine, Lactation

## Physiology and Endocrinology: Nutritional Regulation of Reproduction

**584 Energy balance, dry matter intake, and hormone profiles of cows with ovulatory and non-ovulatory follicles during the first postpartum follicle wave.** S. T. Butler<sup>\*</sup> and W. R. Butler<sup>\*</sup>, Cornell University, Ithaca, NY.

An early resumption of ovulatory activity following parturition is positively associated with subsequent measures of reproductive success.

Postpartum energy balance (EB) affects ovarian follicle development and likelihood of ovulation. This study was carried out to assess whether differences in transition period EB (pre- and postpartum) also contribute to differences in postpartum follicular activity (study period = d -21 to d 30 relative to parturition). First wave follicle development was fol-

lowed via ultrasound in fifty-five mature Holstein cows, and the follicle waves were retrospectively categorized as being ovulatory (O; n=17), non-ovulatory high E2 (NH; n=6), non-ovulatory low E2 (NL; n=24), or cystic (n=8). The cystic cows were excluded, and the remaining data were analyzed by ANOVA and repeated measures ANOVA. Peak plasma estradiol (E2) concentrations were similar in O and NH cows ( $5.8 \pm 0.7$  vs.  $6.0 \pm 1.1$  pg/ml;  $P=0.8$ ), and were higher in both groups ( $P<0.001$ ) than NL cows ( $1.2 \pm 0.5$  pg/ml). Energy balance in the NL cows during the pre- and postpartum periods ( $10.8 \pm 0.4$  and  $-12.2 \pm 0.6$  Mcal/d) were less favorable than in either the O ( $13.6 \pm 0.5$  and  $-8.3 \pm 0.8$  Mcal/d; both  $P<0.001$ ) or NH cows ( $15.8 \pm 0.8$  and  $-9.0 \pm 1.2$  Mcal/d;  $P<0.001$  and  $P<0.05$ ). Divergence between groups in EB started as early as d -21 and continued through d 30. There were no differences between groups in milk yield ( $P>0.2$ ), and differences in EB were paralleled by differences in DMI. In accordance with the EB results, NL cows had lower insulin and glucose and higher NEFA than O cows (all  $P<0.001$ ) and NH cows ( $P<0.05$ ,  $P=0.16$  and  $P<0.06$ , respectively). The NL cows had a more severe negative EB nadir compared with O ( $P<0.08$ ) and NH cows ( $P<0.05$ ). In conclusion, EB was least favorable in NL cows. This status commenced up to 3 weeks prior to parturition and carried over through the postpartum follicular wave. Conversely, NH cows had a similar EB profile to O cows and produced similar levels of E2, but failed to ovulate.

**Key Words:** Energy Balance, Ovulation, Estradiol

**585 Effects of feeding menhaden fish meal or Ca salts of fish oil fatty acids on uterine fatty acids composition, COX-2 level and PGF<sub>2α</sub> production in early lactating cows.** A. Heravi Moussavi<sup>1</sup>, R. O. Gilbert<sup>2</sup>, T. R. Overton<sup>2</sup>, D. E. Bauman<sup>2</sup>, and W. R. Butler<sup>2</sup>, <sup>1</sup>Dept. of Animal Science, Ferdowsi University, Mashhad, Iran, <sup>2</sup>Cornell University, Ithaca, NY.

The study was designed to test the effects of dietary fatty acid supplementation on uterine fatty acid composition, cyclooxygenase-2 (COX-2) level, and PGF<sub>2α</sub> production in early lactating cows. From d 5-50 postpartum, cows (n = 30; 6/treatment) were fed diets that were isonitrogenous, isoenergetic and isolipid containing 0 (Control), 1.25, 2.5 or 5 % menhaden fish meal (FM) or 2.3% Ca salts of fish oil fatty acids (CaFOFA). At day 23 postpartum, cows were induced to a synchronized ovulatory cycle with an i.m. injection of 100 μg of GnRH followed after 7 days by i.m. administration of 30 mg of PGF<sub>2α</sub> and a second injection of GnRH 48 h later. On d 15 after second GnRH injection, cows were injected with 100 IU oxytocin (i.v.) at 11.00 h. Blood samples were collected at 15-min intervals from 1 h before to 3 h after the oxytocin injection and at 30-min intervals from 3 to 4 h after oxytocin injection to monitor uterine secretion of PGF<sub>2α</sub> measured as 13,14-dihydro 15-keto PGF<sub>2α</sub> (PGFM). After completion of blood sampling, uterine endometrium biopsy samples were taken for fatty acid analysis and Western blot for COX-2 concentration. The uterine fatty acid composition of eicosapentaenoic acid (EPA, C20:5, n-3) and docosahexaenoic acid (DHA, C22:6, n-3) were significantly ( $P<0.0001$ ) increased by supplementation with fish meal and CaFOFA to as much as 3-fold. Arachidonic acid (AA, C20:4, n-6) was decreased by adding 5 % FM ( $P<0.05$ ). The uterine level of COX-2 protein and PGFM area under curve after administration of oxytocin were not significantly different among diets. Results from this experiment demonstrate that dietary fatty acid supplementation significantly increases uterine omega-3 fatty acid concentration with no apparent effect on COX-2 level and PGF<sub>2α</sub> production after oxytocin challenge in early lactation dairy cows.

**Key Words:** Fish meal, COX-2, PGF<sub>2α</sub>

**586 Effect of fat sources differing in fatty acid profile on fertilization rate and embryo quality in lactating dairy cows.** R. L. A. Cerri<sup>1</sup>, R. G. S. Bruno<sup>1</sup>, R. C. Chebel<sup>1</sup>, K. N. Galvao<sup>1</sup>, H. Rutigliano<sup>1</sup>, S. O. Juchem<sup>1</sup>, W. W. Thatcher<sup>2</sup>, D. Luchini<sup>3</sup>, and J. E. P. Santos<sup>1</sup>, <sup>1</sup>University of California, Davis, <sup>2</sup>University of Florida, Gainesville, <sup>3</sup>Bioproducts, Inc..

Holstein cows, 154, were randomly assigned to one of two treatments consisting of either a Ca salt of linoleic and trans fatty acids (LTFA) or of palm oil (PO). Cows consumed 250 and 350 g/d of the supplemental fats during the last 25 d of gestation and first 60 d in milk (DIM), respectively. Cows were pre-synchronized with a CIDR and GnRH at 30 DIM, followed 7 d later by PGF<sub>2α</sub> and CIDR removal. The Ovsynch protocol was initiated 2 d after CIDR removal and all cows were timed AI by the

same person 12 h after the last GnRH. Blood samples were collected at all injections in the Ovsynch and then at d 1, 3 and 5 d after AI for P4 analysis. Ovaries were examined by ultrasound throughout the synchronization protocol, and cows were flushed at 5.5 d after timed AI. Structures were evaluated visually and using vital staining with propidium iodine followed by Hoescht. Continuous, binomial, and count data were analyzed using the GLM, GENMOD, and LOGISTIC procedures of SAS (2001), respectively. Ovulation to the first and second GnRH and double ovulation to the second GnRH of the Ovsynch were similar ( $P>0.25$ ) across treatments and averaged, respectively, 83.7, 86.4, 19.1%. Diameter of the ovulatory follicle at the second GnRH of the Ovsynch and of the CL at embryo collection were similar ( $P>0.80$ ) across treatments and averaged, respectively, 18.6 and 22.2 mm. A total of 86 structures were recovered (41 LTFA and 45 PO), and recovery rate (structure/CL) was similar for LTFA and PO (51.9 vs 54.9%;  $P>0.15$ ). Fertilization rate (87.2 vs 73.3%;  $P=0.11$ ), number of total cells (19.4 vs 14;  $P=0.13$ ), and percentage of live cells (94.2 vs 85.3%;  $P=0.09$ ) all tended to be higher for LTFA than PO. Similarly, the percentage of high quality embryos (grades 1 and 2) were higher for LTFA compared with PO (73.5 vs 51.5%;  $P=0.06$ ), and number of accessory sperm cells attached to the zona pelucida/structure were higher (34.3 vs 21.5;  $P<0.001$ ) for LTFA than PO. These results suggest that feeding Ca salts of LTFA improve fertilization rate and embryo quality in lactating dairy cows. Supported by NRI/USDA Grant 2003-02742.

**Key Words:** Embryo, Fatty Acids, Dairy Cows

**587 Expression of growth hormone receptor and IGF-I mRNA in the reproductive tissues of early postpartum dairy cows.** M. L. Rhoads\*, J. P. Meyer, S. J. Kolath, W. R. Lamberson, and M. C. Lucy, University of Missouri, Columbia.

The growth hormone (GH)/IGF-I system plays a critical metabolic role in dairy cattle. In liver, GH receptor (GHR) and IGF-I are dynamically regulated by lactation and energy balance. Less is known about the regulation of GHR and IGF-I mRNA in reproductive tissues. The objective of this study was to measure total GHR (tGHR) and IGF-I mRNA expression in the liver, uterus, corpus luteum (CL) and follicle in Holstein cows (n=21) sampled three times during early lactation. GnRH was administered within 15 d postpartum to induce first ovulation. Nine d after ovulation (23 ± 1 d postpartum) the liver, uterus, CL and first wave dominant follicle (DF; follicular fluid aspiration for granulosa cell collection) were sampled. PGF<sub>2α</sub> and GnRH were injected 7 and 9 d after sample collection to synchronize the second (41 ± 1 d postpartum) and third (60 ± 1 d postpartum) tissue collections. Total RNA was isolated and used for mRNA analysis by real-time quantitative PCR. Uterus, CL and DF expressed less tGHR (0.1 ± 0.8, 8.3 ± 0.9 and 1.4 ± 0.9 AU, respectively;  $P<0.01$ ) and IGF-I (4.3 ± 2.7, 12.0 ± 2.9 and 6.4 ± 3.1 AU, respectively;  $P<0.01$ ) than liver (24.4 ± 0.8 and 47.2 ± 2.7 AU, respectively). GHR1A mRNA in liver and tGHR and IGF-I mRNA in liver and reproductive tissues were unaffected by stage of lactation ( $P>0.10$ ). The tGHR mRNA was correlated with IGF-I mRNA in liver ( $r=0.42$ ;  $P<0.01$ ), uterus ( $r=0.78$ ;  $P<0.01$ ) and CL ( $r=0.40$ ;  $P<0.01$ ), but not DF. Liver IGF-I mRNA ( $r=0.33$ ;  $P<0.01$ ) and plasma IGF-I concentrations ( $r=0.31$ ;  $P<0.02$ ) were correlated with body condition score (BCS) from calving to sample collection. The effects of BCS loss on reproductive tissues were opposite to that observed in liver. The tGHR mRNA in CL ( $r=0.37$ ;  $P<0.01$ ) and the IGF-I mRNA in DF ( $r=0.31$ ;  $P<0.05$ ) increased with greater BCS loss. The metabolic control of tGHR and IGF-I differed between liver and reproductive tissues. Reproductive tissues may compensate for low BCS with localized synthesis of tGHR and IGF-I.

**Key Words:** Growth Hormone Receptor, IGF-I, Reproduction

**588 Influence of postpartum nutrition of primiparous beef cows on insulin-like growth factor binding proteins in follicular fluid and plasma.** I. Rubio\*, F. J. White, N. H. Ciccioli, R. P. Wettemann, and L. J. Spicer, Oklahoma Agricultural Experiment Station, Oklahoma State University, Stillwater.

Effect of postpartum nutrient intake on insulin-like growth factor binding proteins (IGFBPs) in dominant follicles (DF) and plasma was evaluated at 56 ± 9 d postpartum in anovulatory primiparous Angus x Hereford cows. Body condition score (BCS) at calving was 4.8 ± 0.2. Cows (n=28) were blocked based on BCS and randomly assigned to one of two nutritional treatments at calving; moderate (M), 2.3 kg/d of a 40

% CP supplement and ad libitum hay, or high (H), ad libitum access to a 12% CP-50 % concentrate diet and hay. Blood samples were collected twice a week starting at 30 d postpartum. Ovarian follicles were evaluated daily by ultrasonography commencing at 42 d postpartum. When growth of DF plateaued, follicular fluid (FF) was obtained by transvaginal ultrasound-guided follicular aspiration. Data were analyzed using the MIXED procedure of SAS and Pearson correlation coefficients. Concentrations of IGF-I in FF were greater ( $P < 0.01$ ) for H ( $34.0 \pm 10.7$  ng/ml) than M ( $23.6 \pm 8.5$  ng/ml) cows, but concentrations of progesterone, androstenedione, and estradiol in FF were not influenced ( $P > 0.10$ ) by treatment. Concentrations of IGFBP-4 and -5 in plasma were 30% greater ( $P < 0.01$ ) in H than in L cows. Concentrations of IGFBP-4 and -5 in FF were 68 and 48%, respectively, greater ( $P < 0.05$ ) for H than M cows. Concentrations of IGFBP-2 and -3 in plasma and FF were not influenced by treatment. Concentration of IGFBP-2 and -5 in plasma at follicular aspiration were positively correlated with follicle size ( $P < 0.05$ ) and IGFBP-2 in FF was correlated with follicle size. BCS at calving was positively correlated with IGFBP-2, -4 and -5 in plasma at aspiration of follicles. Concentration of IGF-I in plasma at aspiration and in FF were positively correlated with IGFBP-3 and -4 in FF. Although concentrations of IGFbps in FF were not correlated with IGFbps in plasma, similar increases in both systemic and intrafollicular IGFBP-4 and -5 in cows with greater nutrient intake, indicate that these two IGFbps may be regulated by the same nutritionally driven endocrine or metabolic changes.

**Key Words:** Insulin-like Growth Factor Binding Proteins, Nutrition Postpartum, Cow

**589 Reproductive performance of primiparous and multiparous cows fed whole soybeans before breeding.** N. M. Long<sup>\*2</sup>, G. M. Hill<sup>1</sup>, J. F. Baker<sup>1</sup>, W. M. Graves<sup>2</sup>, M. A. Froetschel<sup>2</sup>, B. G. Mullinix, Jr.<sup>1</sup>, and D. H. Keisler<sup>3</sup>, <sup>1</sup>University of Georgia, Tifton, <sup>2</sup>University of Georgia, Athens, <sup>3</sup>University of Missouri, Columbus.

Effects of supplemental energy before breeding on primiparous (PC;  $508.84 \pm 35.8$  kg BW) and multiparous (MC  $581.4 \pm 66.57$  kg BW) reproductive performance were determined using Angus (A; PC=17; MC=36) and Polled Hereford (PH; PC=12, MC=11) beef cows. Parity (P), breed, cow and calf initial BW, and calf age were used to rank cows before random assignment to control (C; no supplementation, PC = 15, MC= 25) or soybean (S; cracked whole soybeans 2.26 kg/cow daily, PC=14; MC=24) treatments (T) during a pre-breeding period (Feb 11 to Apr 11). The breeding interval began April 14, estrual activity was monitored visually and by Heatwatch<sup>®</sup> system, and cows were bred A.I.(d 1 to d 44), or natural service (fertile bulls, d 45 to d 71). Cow blood serum (Feb 11 and Apr 11) was analyzed for triglyceride, cholesterol, low and high density lipids, and leptin (TRIG, CHO, LDL, HDL, LEP, mg/dl). Calf ADG (kg) from Feb 11 to end of breeding season, with birthweight as a covariate was affected ( $P < 0.10$ ) by P (PC and MC within C and S, respectively, were : 0.91, 0.95, 0.93, 0.98, SE = 0.023). Pregnancy rate (%) on Sep 17, for PC and MC within C and S, respectively, were: 66.7, 85.0, 62.5, 58.3, SE = 8.2, and it was unaffected by T and P. Initial values for CHO, LDL, HDL and TRIG were unaffected ( $P > 0.10$ ) by T or P, but all increased by Apr 11, resulting in differences (adjusted using Feb 11 data) shown in the table. Leptin values increased from Feb 11 to Apr 11 for all treatments except PC-C. Feeding S to PC cows resulted in increased LEP ( $P = 0.05$ ), and elevated TRIG, CHO, LDL, and HDL of PC-S to levels comparable with MC.

Item	Control (C)		Soybeans (S)		SE	T	P	TxP
	PC	MC	PC	MC				
TRIG (APR 11)	28.1	25.9	32.6	29.7	1.55	**		
CHO (APR 11)	133.7	180.7	190.9	202.8	8.10		*	
HDL (APR 11)	104.6	143.1	145.5	160.1	6.20		*	
LDL (APR 11)	23.4	32.2	39.2	36.6	2.06			**
LEP					SE between dates =			
(Feb 11) <sup>k</sup> LEP	6.8a	5.5b	6.7bm	4.1bn	0.58 (a,b)			
(APR 11) <sup>k</sup>	5.7any	9.0am	8.4ax	8.6a	SE between T = 0.81 (n, m or x,y) [P = 0.05]			

<sup>k</sup>LEP had T x P x Date ( $P < 0.01$ ); T an P tested by Satterthwaite option, Proc Mixed, SAS.

**Key Words:** Cow, Soybean, Leptin

**590 Recombinant oleptin does not acutely accelerate the frequency of LH pulses at any developmental stage in normal and growth-restricted heifers.** D. A. Zieba<sup>1,2</sup>, M. Amstalden<sup>1,2</sup>, S. Morton<sup>1,2</sup>, D. H. Keisler<sup>3</sup>, and G. L. Williams<sup>\*1,2</sup>, <sup>1</sup>Animal Reproduction Laboratory, Texas A&M University Agricultural Research Station, Beeville, TX, <sup>2</sup>Department of Animal Science and Center for Animal Biotechnology and Genomics, College Station, TX, <sup>3</sup>Department of Animal Science, University of Missouri, Columbia.

Leptin plays critical roles in communicating nutritional status to the central reproductive axis in mammals and is necessary for sexual maturation. However, there is an emerging consensus that leptin may serve merely as a permissive signal for puberty. This is supported by the fact that chronic treatment of well-fed heifers with recombinant ovine leptin (oleptin) fails to accelerate the timing of puberty. Nonetheless, oleptin acutely stimulates gonadotropin secretion during nutritional stress in cows, and prevents fasting mediated reductions in frequency of LH pulses in peripubertal heifers. Therefore, objectives herein were to determine whether leptin could act to accelerate acutely the frequency of LH, and putatively GnRH, pulses at some critical point(s) of development in heifers fed normal or growth-restricted diets Ten-month old prepubertal heifers were assigned randomly to one of two dietary groups: 1) Normal Growth (a BW gain of 0.68 kg/d; and 2) Restricted Growth (a BW gain of 0.3 kg/d). Every 5 wk, each heifer received in random order on each day of a 2-d experiment, three hourly injections of either saline or oleptin (0.2  $\mu$ g/kg BW i.v.). Blood samples were collected every 10-min for 5 h during each experimental period. The experiment ended when all normal-growth heifers had reached puberty. None of the restricted-growth heifers reached puberty during the study. Mean circulating concentrations of leptin were approximately 70% lower ( $P < 0.001$ ) in restricted- compared to normal-growth heifers. Mean plasma LH and amplitude of LH pulses in restricted-growth heifers were less ( $P < 0.01$ ) than in normal-growth heifers. Leptin treatment acutely increased ( $P < 0.002$ ) mean circulating leptin 1.7- to 2.0-fold and slightly but significantly ( $P < 0.02$ ) increased mean concentrations of LH over all periods, regardless of diet. Neither frequency nor individual characteristics of LH pulses were altered acutely by leptin treatment at any age. We conclude that changes in sensitivity of the hypothalamic-hypophyseal axis to leptin do not occur as a function of sexual maturation (USDA-NRI 00-35203-9132).

**Key Words:** Heifer, Leptin, LH

**591 Effect of prenatal nutrition on plasma glucose at birth and weaning.** D. W. Kastner<sup>\*</sup>, I. Rubio, F. J. White, N. H. Ciccioli, and R. P. Wettemann, Oklahoma Agricultural Experiment Station, Stillwater, OK.

Two experiments (Expt) were conducted to determine the effect of high (H) or low (L) energy and protein diets of cows during gestation on

plasma concentrations of glucose in calves at birth and after weaning. In Expt 1, mature Angus x Hereford cows received a 12% CP - 50% concentrate diet ad libitum (H, n=12), or grazed dry prairie grass and received 0.45 kg/d of a 40% CP supplement (L, n=10) from approximately 118 to 202 d of gestation. Calves were born between February 12 and April 3. H cows gained  $143 \pm 6$  kg and  $2.1 \pm 0.2$  body condition scores (BCS; 1=emaciated, 9=obese) and L cows gained  $31 \pm 7$  kg and  $0.2 \pm 0.2$  BCS. In Expt. 2, H cows (n=10) received a 50% concentrate diet ad libitum and L cows (n=9) received 4 kg/d of prairie hay and 0.45 kg/d of a 20% CP supplement from approximately 78 to 174 d of gestation. H cows gained  $138 \pm 4$  kg and  $1.7 \pm 0.2$  BCS and L cows gained  $7 \pm 4$  kg and lost  $0.3 \pm 0.1$  BCS. Cows calved between March 13 and April 29. Birth weights of calves were not influenced by diet that cows received during mid-gestation. Weaning weights were greater for calves from H than L cows in Expt 1 ( $P < 0.06$ ) and 2 ( $P < 0.01$ ). At 30 d of treatment (Expt 2), H cows had greater ( $P < 0.05$ ) concentrations of glucose, thyroxine and NEFA in plasma than L cows. Concentrations of glucose in plasma of calves at birth were not influenced by treatment in either experiment. At weaning (Expt 1), concentrations of glucose were greater ( $P < 0.05$ ) in H than L cows but NEFA and IGF-I levels were not influenced by treatment. H and L calves (Expt 2) responded differently to a glucose tolerance test after weaning. Concentrations of glucose with time after infusion were greater ( $P < 0.01$ ) at 3 wk after weaning for H than L calves and tended to be greater ( $P < 0.10$ ) for H than for L calves at 3.5 mo after weaning. We conclude that exposure of cows to high energy diets that cause increased glucose in plasma during mid-gestation, may influence regulation of concentrations of glucose in plasma of calves after weaning.

**Key Words:** Calf, Glucose, Prenatal

**592 The role of food intake on estrous cyclicity and reproductive potential in white-tailed deer (*Odocoileus virginianus*).** E. L. Monaco<sup>\*1</sup>, R. L. Stanko<sup>1</sup>, and D. G. Hewitt<sup>2</sup>, <sup>1</sup>Department of Animal and Wildlife Sciences, Texas A&M University, Kingsville, <sup>2</sup>Caesar Kleberg wildlife Research Institute, Texas A&M University, Kingsville.

Nutritional status at the time of breeding can influence reproduction of cervids, but specific effects on timing of reproduction are not fully understood. We studied the effects of a non-restricted diet versus a restricted diet on deer reproduction. Baseline data were collected in Year 1 when penned does (n=16) were feed a high quality pellet (18% CP, 36% CF, Moormans<sup>®</sup> 6193) and alfalfa hay ad libitum. In Year 2, does were allocated randomly to feed restriction treatments which occurred from September (week 1) through early December (Early, E; n=8) or mid-January (Late, L; n=8). A ration of a 50:50 mix of high quality:low quality pellet (16% CP, 55% CF, Purina<sup>®</sup> 34A7) and sudan hay was fed. Amount fed per day was calculated as 80% of average DMI from companions of similar size (n=8). Blood was taken via jugular venipuncture on weeks 1, 4, 7 through 26, and 30 and body weights (BW) were recorded. Serum was analyzed for progesterone, triiodothyronine (T<sub>3</sub>), and thyroxine (T<sub>4</sub>). Estrous cyclicity and reproductive outcome was recorded for both years. Feed restriction decreased ( $P < .01$ ) BW, T<sub>3</sub>, and T<sub>4</sub>. Serum T<sub>4</sub> was lower ( $P < .05$ ) in L than E does. However, BW and T<sub>3</sub> were similar ( $P > .1$ ) between treatments. Between years, feed restriction delayed ( $P < .01$ ) onset of estrous cyclicity and increased ( $P < .01$ ) the number of estrous cycles before conception. Week of first estrous cycle and week of conception were delayed ( $P < .01$ ) in L does. Data suggest that white-tailed does consuming a low quality diet prior to the breeding season can successfully reproduce if high quality food becomes available.

**Key Words:** Deer, Nutrition, Reproduction

**593 Performance and semen quality of yearling bulls grazing tall fescue pastures.** G. M. Schuenemann<sup>\*1</sup>, J. C. Waller<sup>1</sup>, F. M. Hopkins<sup>2</sup>, H. S. Adair<sup>2</sup>, N. R. Rohrbach<sup>1</sup>, F. N. Scenna<sup>1</sup>, D. I. Bryant<sup>1</sup>, A. M. Saxton<sup>1</sup>, J. W. Oliver<sup>3</sup>, J. C. Riggins<sup>4</sup>, and F. N. Schrick<sup>1</sup>, <sup>1</sup>Department of Animal Science, University of Tennessee, Knoxville, <sup>2</sup>Department of Large Animal Clinical Sciences, University of Tennessee, Knoxville, <sup>3</sup>Department of Comparative Medicine, University of Tennessee, Memphis, <sup>4</sup>Highland Rim Experiment Station, University of Tennessee, Springfield.

During a two-year study, performance and semen quality of yearling beef bulls grazing Kentucky 31 tall fescue (*Festuca arundinacea* Schreb.) infected with *Neotyphodium coenophialum*, an ergot alkaloid-producing fungal endophyte (E+; n = 20/yr); E+ plus ladino (*Trifolium repens*) and red (*T. pratense*) clovers (E+Cl; n = 10/yr); or Jesup tall fescue with the non-ergot alkaloid-producing endophyte strain MaxQ#8482 (MaxQ; n = 10/yr) were determined. Bulls were grouped by scrotal circumference (SC;  $28 \pm 1.6$  cm); BW ( $303 \pm 13.5$  kg), breed composites, and age ( $296 \pm 20.2$  d) to graze E+, E+Cl, or MaxQ tall fescue pastures from November to July (224 d). Blood samples, ADG, SC and rectal temperatures (RT) were collected every 14 d. Scrotal temperatures (ST) were obtained by thermography before semen collection in May and June. Semen samples were immediately evaluated for motility and normal morphology. A mixed model procedure that included treatment, time, year, pasture (treatment), and all interactions as fixed effects was used to compare differences among treatment. Bulls grazing E+ and E+Cl pastures had increased RT ( $39.1 \pm 0.04$  and  $39.0 \pm 0.04$  vs  $38.7 \pm 0.06^\circ\text{C}$ ;  $P < 0.0001$ ) and decreased prolactin ( $28.5 \pm 4.3$  and  $39.5 \pm 6.2$  vs  $102.5 \pm 6.2$  ng/mL;  $P < 0.0001$ ) compared to bulls grazing MaxQ pastures. However, bulls grazing E+ had lower ST ( $32.7 \pm 0.2$  vs  $33.1 \pm 0.2$  and  $33.5 \pm 0.2^\circ\text{C}$ ;  $P = 0.05$ ) and decreased ADG ( $0.6 \pm 0.02$  vs  $0.85 \pm 0.03$  and  $0.8 \pm 0.03$  kg/d;  $P < 0.0001$ ) compared to bulls grazing E+Cl and MaxQ pastures. Testosterone, SC, and semen motility and morphology did not differ between treatments. In conclusion, motility and gross morphology of semen were not altered in bulls grazing E+ tall fescue pastures. Addition of clover to E+ pastures reduces the adverse effects on growth performance and scrotal temperature associated with fescue toxicosis.

**Key Words:** Tall Fescue, Bull, Fertility

**594 Effects of P.G. 600 treatment at weaning on reproductive performance of sows limit-fed during lactation.** B. R. Horsley<sup>\*</sup>, M. J. Estienne, A. F. Harper, and J. W. Knight, Virginia Polytechnic Institute and State University, Blacksburg.

The objective was to determine whether treatment with 400 I.U. PMSG and 200 I.U. hCG (P.G. 600; Intervet America, Inc.; Millsboro, DE) at weaning would improve reproductive performance of sows limit-fed during lactation. First- and second-parity, crossbred sows ( $213.3 \pm 2.4$  kg BW and  $17.2 \pm 0.5$  mm last-rib backfat thickness) nursing  $10.0 \pm 0.3$  pigs each were allowed ad libitum access to feed (AL; n = 18) or were limited to 3.2 kg of feed/d (L; n = 35) during an 18-d lactation. AL sows consumed more feed ( $P < 0.01$ ) than did L sows ( $5.3$  vs.  $3.1$  kg/d; SE = 0.05). L sows lost more ( $P < 0.01$ ) BW ( $22.2$  vs.  $2.6$  kg; SE = 2.4) and backfat ( $3.1$  vs.  $0.6$  mm; SE = 0.6) compared to AL sows. There was no effect ( $P = 0.99$ ) of feeding level on pigs weaned ( $88.7 \pm 3.0\%$ ), but pig BW at weaning was greater ( $P < 0.01$ ) for AL sows compared to L sows ( $6.3$  vs.  $5.6$  kg; SE = 0.2). At weaning, L sows received i.m. treatment with P.G. 600 (L + P.G. 600; n = 16) or saline (L + saline; n = 19) and AL sows received saline (AL + saline; n = 18). Sows in estrus by d 7 post-weaning was greater ( $P < 0.05$ ) for AL + saline sows (94.4%) compared to L + saline sows (68.4%), with L + P.G. 600 sows having an intermediate value (87.5%) that was not different ( $P > 0.05$ ) from the other two groups. The weaning to estrus interval ( $5.2 \pm 0.1$  d) and sows pregnant at d 30 post-mating (84.1%) were not different among groups ( $P > 0.1$ ). Following slaughter at d 30 of gestation, the number of corpora lutea ( $17.8 \pm 0.6$ ), number of live embryos ( $10.6 \pm 0.6$ ), embryonic survival ( $61.1 \pm 3.5\%$ ), and embryo weight ( $1.56 \pm 0.07$  g) and crown-rump length ( $27.3 \pm 0.4$  mm) were not different ( $P > 0.1$ ) among groups. In summary, low feed intake during lactation decreased the percentage of sows that displayed estrus within 7 d after weaning, an effect partially remediated by gonadotropin treatment. Pregnancy rate and litter size at day 30 of gestation were similar for AL and L sows and not affected by P.G. 600 in L sows.

**Key Words:** Gonadotropin, Estrus, Sow

**595 Effect of acetate to propionate ratio on clearance of progesterone in the ovid.** D. L. Smith\*, B. A. Costine, and M. E. Wilson, *West Virginia University, Morgantown.*

The objective of these experiments was to determine if a change in the ratio of acetate to propionate (A:P ratio) in hepatic portal blood, draining the gastrointestinal tract, can alter the metabolism of progesterone by the liver. Experiment 1; 4 crossbred, ewe lambs (BW 45.5 + 2.5 kg) were fed for maintenance and given a once daily oral bolus (0.146 Mcal/d) of acetate (0.7 moles) or propionate (0.4 moles) for 11 d. A portal-vein catheter was inserted 14 d prior to collection. Portal and jugular venous blood were simultaneously collected (-0.17, 0.17, .33, 0.5, .66, .83, 1, 1.17, 1.33, 1.5, 1.66, 1.83, 2, 2.33, 2.66, 3, 4, 5, 6, 7 h with respect to feeding and VFA bolus) and serum was analyzed for concentrations of VFA by GLC. Experiment 2; 30 crossbred ewe-lambs, (BW 45.2 + 1.9 kg) were blocked by BW and fed for maintenance for 11 d. On d 12, each lamb was randomly assigned to one of two treatments, and given an oral bolus (0.146 Mcal/d) of acetate (0.7 moles) or propionate

(0.4 moles). Animals received (i.m.) 20 mg progesterone (P<sub>4</sub>) in corn oil. Plasma samples were collected (-0.5, 0.5, 1, 2, 3, 4, 5, 6, 8 h relative to feeding, VFA bolus, and P<sub>4</sub> injection) via jugular venipuncture and circulating concentrations of P<sub>4</sub> were determined by P<sub>4</sub>-RIA. An oral bolus of acetate or propionate caused a mark change in the A:P ratio for at least 4 h. By 24 h after the oral bolus, the A:P ratio returned to baseline. Plasma concentrations of P<sub>4</sub> after the oral bolus of either acetate or propionate began to diverge as early 0.5 h and were different ( $P < 0.05$ ) by 3-h (1.09 + 0.09 ng/ml vs. 2.04 + 0.48 ng/ml) and 4-h (1.20 + 0.09 ng/ml vs. 1.95 + 0.41 ng/ml) for ewe lambs bolused with acetate and propionate, respectively. By 5 h, coincident with the return to baseline A:P ratios seen in Experiment 1, circulating concentrations of P<sub>4</sub> were not different. Changes in the A:P ratio altered the circulating concentrations of P<sub>4</sub> by reducing the metabolic clearance of P<sub>4</sub> when the A:P ratio was decreased.

**Key Words:** Acetate, Propionate, Progesterone

## Production, Management and the Environment: Heat Stress and Environment

**596 Response of heat stressed dairy cattle to low-pressure soaking or high-pressure misting heat abatement systems.** M. J. Brouk\*<sup>1</sup>, J. P. Harner, III<sup>2</sup>, J. F. Smith<sup>1</sup>, W. F. Miller<sup>1</sup>, and B. Cvetkovic<sup>1</sup>, <sup>1</sup>*Department of Animal Sciences and Industry, Kansas State University,* <sup>2</sup>*Department of Agricultural and Biological Engineering, Kansas State University.*

Eight lactating Holstein cows (4 primiparous and 4 multiparous) were arranged in a replicated 4x4 Latin square design to evaluate the effect of three different heat abatement systems. Respiration rate and surface temperature (right shoulder, left shoulder and rear udder) were measured and recorded at 5-min intervals during the study. Surface temperatures were measured with an infrared thermometer. Body temperature was recorded with a vaginal probe once per min and averaged by 5 min intervals prior to data analysis. Animals were housed in freestall barns and milked 2x. During testing, cattle were moved to a tiestall barn for a period of 2 hr starting at 14:00 hr on 4 days of intense heat stress. Treatments were control (C), low-pressure soaking applied for 1 min on 5 min intervals (LPS), continuous high-pressure misting with 2 (6.4 L/hr) nozzles (HP-2) or continuous high-pressure misting with 4 (6.4 L/hr) nozzles (HP-4). In addition to water application, all cooling treatments had supplemental airflow (215 m/min). Cows cooled by the LPS or HP-4 system became soaked during the 85 min the cooling treatments were applied. Respiration rates were lowered ( $P < 0.05$ ) when cows were cooled (114.4, 98.2, 89.3 and 82.5 breaths per min for C, HP-2, HP-4 and LPS treatments, respectively). Cows cooled with either LPS or HP-4 had lower ( $P < 0.05$ ) respiration rates than those cooled by HP-2. Surface temperatures of the right and left shoulders were lower ( $P < 0.05$ ) for cooled cows as compared to controls. Cows cooled by HP-4 had lower ( $P < 0.05$ ) shoulder surface temperatures than those cooled by HP-2 or LPS. Rear udder surface temperature was also lower ( $P < 0.05$ ) for cows cooled by either HP-4 or LPS as compared to controls. Respiration rates were decreased by 14, 37 and 48% for HP-2, HP-4 and LPS cooling systems, respectively, during the 85 min evaluation period. The combination of cooled respiratory air and surface soaking of the HP-4 treatment was more effective in reducing shoulder surface temperature than LPS. These data suggest that soaking of cattle with either the LPS or HP-4 treatment provided superior heat abatement as compared to HP-2 or C.

**Key Words:** Heat Stress, Cow Cooling, Facilities

**597 Impact of air velocity and direction of flow upon respiration rate, body surface temperature and body temperature of heat stressed dairy cattle.** M. J. Brouk\*<sup>1</sup>, J. P. Harner, III<sup>2</sup>, J. F. Smith<sup>1</sup>, W. F. Miller<sup>1</sup>, and B. Cvetkovic<sup>1</sup>, <sup>1</sup>*Department of Animal Sciences and Industry, Kansas State University,* <sup>2</sup>*Department of Agricultural and Biological Engineering, Kansas State University.*

Seven heat stressed, mid-lactation Holstein cows averaging 250 days in milk and producing an average of 38.3 kg of milk were arranged in a 7x7 Latin square design to determine the effects of air velocity and direction of flow on cow cooling. Animals were housed in freestall barns and milked 2x. Cows were moved to a tiestall barn for a period of 2 hr at

14:00 hr each afternoon of testing. Respiration rate and surface temperatures were measured and recorded at 5-min intervals during the 2 hr testing period. Surface temperatures were determined with an infrared thermometer and body temperature was measured and recorded once per min with a data logger and vaginal probe and subsequently averaged by 5-min intervals prior to data analysis. Treatments were control (C) or one of six different cooling treatments. All cooling treatments included a low-pressure soaker system which soaked the cows for 1 min on 5-min intervals. Supplemental airflow was provided by axial flow fans at one of three flow rates; 183 (1), 229 (2) or 275 (3) m/min. Airflow was either from the front to rear (FRT) or from the right side (SIDE) of the animal. Cooling treatments were FRT-1, FRT-2, FRT-3, SIDE-1, SIDE-2 or SIDE-3. Respiration rates were lowered ( $P < 0.01$ ) by all cooling treatments as compared to controls. Cows cooled with SIDE-3 had lower ( $P < 0.01$ ) respiration rates than cows cooled with FRT-1 or SIDE-2. Rear udder surface temperature was lowered ( $P < 0.05$ ) when cows were cooled by FRT-3, SIDE-2 or SIDE-3 as compared to the controls. Right shoulder temperature was reduced more compared to left shoulder temperature when the airflow was from the right side as opposed from the front. The impact of air velocity on surface temperature was variable, but more predictable when from the front as opposed to the side of the animal. These data indicate that the velocity and direction of supplemental airflow elicit different responses from heat stressed dairy cows. Airflow from the front to the rear of the animal may result in greater cooling than air directed at the side of the animal.

**Key Words:** Heat Abatement, Facilities, Cow Cooling

**598 Impact of soaking cows housed in a tunnel ventilated barn equipped with evaporative pads located in Thailand.** D. V. Armstrong<sup>1</sup>, J. F. Smith\*<sup>2</sup>, M. J. Brouk<sup>2</sup>, V. Wuthironarith<sup>3</sup>, and J. P. Harner, III<sup>2</sup>, <sup>1</sup>*University of Arizona, Tucson,* <sup>2</sup>*Kansas State University, Manhattan,* <sup>3</sup>*Charoen Pokphanol Group Co., LTD, Bangkok, Thailand.*

Ten lactating Holstein cows (10 multiparous) were arranged in a replicated 5 x 5 Latin Square design to evaluate the effect of soaking frequency and volume of water per soaking on lactating cows housed in tunnel ventilated and evaporative cooled freestall barn. Rectal temperature, respiration rate and body surface temperature (shoulder, thurl and rear udder) were measured every 5 minutes. Treatments were control (C), soaking every 5 min with 1L (5+1) or 2L (5+2), and soaking every 10 min with 1L (10+1) or 2L (10+2). Average ambient temperature and humidity were 30.3°C and 68% and 26.9°C at 86% in the barn. Water was applied manually from the shoulder to the tail and had a temperature of 27°C. Treatments were applied after 3 initial measurements were taken. Seventeen measurements were taken during treatment application and 5 measurements were taken after the treatments were stopped. Air velocity over the shoulder of the cows was 110 m/min. Respiration rate and body surface temperature for all treatments were lower than the control except for rear udder surface temperature of 1+10. Rectal temperature for 1+5, 2+5, and 2+10 were lower than the control. Respiration rate for 1+5 and 2+5 were lower than 1+10. These data suggests that soaking can be used in combination with tunnel ventilation and evaporative pads to reduce heat stress.