serum (1.21 fold, $P < 0.05$) and in milk (1.35 fold, $P < 0.05$). Whole blood GSHpx activities in E3Se and E1Se were 143% higher ($P < 0.05$) than those in TW and CON. SCC at wk 2 postpartum in E1Se and TW were 8.48 % lower ($P < 0.05$) than those in E3Se and CON. Clinically, no mastitis or retained placenta occurred in these goats. The correlation of iron concentrations between milk and blood serum, or the correlations among lactoferrin, transferrin, and SCC were not significant ($P > 0.05$). In conclusion, intramuscular injection of high dose vit E and Se to preparturient goats does prevent abruptly drop of vit E level in their blood plasma at parturition. Preparturient injections of vitamin E and Se did not markedly effect somatic cell counts in postparturient dairy goats.

Key Words: Selenium, Somatic cell count, Vitamin E

453 Genetic parameters for milk yield in dairy goats across lactations in Germany. B. Zumbach[1,2], S. Tsuruta*[1], I. Misztal[1], and K. J. Peters[2], [1]*University of Georgia*, *Athens*, [2]*Humboldt University*, *Berlin, Germany*.

Breeding value estimation for dairy goats in Germany is still based on herd mate comparison within breeding society. The objective of this study is to estimate genetic parameters for milk yield based on a test day model as basis for a new national evaluation. For the analysis 35,463, 29,871, and 23,103, test day records from lactations 1, 2 and 3 from 5.217, 4.125, and 3.133 animals, respectively, were used. The data between 1987 and 2003 were obtained from 6 German breeding societies. The multiple trait (lactation 1-3) repeatability model included the fixed effects of herd-year (1239 levels), litter size ($1, 2 \geq 3$), kidding season (1, 2, .., 11), and days in milk of 3rd order (1-270) nested within herd-year, and the random effects of animal additive and permanent environment. The 3-trait random regression model included also the random regressions based on 2nd order Legendre polynomials for animal additive and permanent environmental effects. Heritability estimates in the repeatability model were 0.27±0.02, 0.20±0.02, and 0.37±0.02 for the 1st, 2nd and 3rd lactation, respectively. Genetic correlations between lactations were 0.69 (1-2), 0.77 (2-3), and 0.43 (1-3), respectively. Heritability estimates from the random regression model decreased continuously in the 1st and 2nd lactation from the beginning to the end of the lactation, and increased at the extreme, with average values of 0.28 and 0.26. Estimates in the 3rd lactation showed a maximum in the middle of lactation, averaging 0.36. Genetic correlations between lactations averaged 0.60 (1-2), 0.65 (2-3), and 0.44 (1-3), respectively. Despite the small data set and restricted relationship structure - use of selected males in natural service within herds - the estimates are reasonable with the exception of estimates from the 3rd lactation, which seem inflated. Genetic evaluation can be based on estimates from lactations 1 and 2.

Key Words: Dairy goats, Genetic parameters, Test day model

Horse Species: Equine Nutrition

454 Endocrine changes in peri-parturient mares and their newborn. E. L. Berg*, D. L. Meyer, and D. H. Keisler, *University of Missouri*, *Columbia*.

The metabolic events that the female endures as she transitions from the pregnant to non-pregnant condition are decisive, dramatic, and challenging. Our objective was to characterize a portion of this process via endocrine changes in peri-parturient mares and their offspring. Nine pregnant Quarter Horse mares, aged 4-21 y, and their newborn were used. Once weekly, 2 wk prior to their predicted parturition date, pregnant mares were weighed, body condition scored (BCS), and blood sampled via jugular venipuncture. Within 2 h of parturition and before foals nursed (d 0), blood samples were taken from mares and foals, and a milk sample collected from the mares. Blood from foals, and blood and milk from mares were also collected at 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4 4.5, 5, 12, 19, 26, 33 and 61 d post-partum. Blood and milk serum were assayed for concentrations of leptin, IGF-1, and TSH. On d 0, 5, 12, 19, 26, 33 and 61 mares and foals were weighed and BCS. Ultrasound images of fat depth and muscle area of the longissimus dorsi immediately cranial to and parallel with the last rib on the left side of foals were measured to characterize changes in fat depth and muscle area over time. Time series analysis revealed no change in mare blood serum concentrations of IGF-1 or TSH over time ($P>0.07$), nor were there any changes in foal blood serum concentrations of leptin or TSH over time ($P>0.10$). Mare blood serum leptin changed dramatically over time ($P<0.01$), decreasing from d 0 to d 5. Foal blood serum IGF-1 increased ($P<0.01$) to d 19 where it remained for the duration of study. Milk serum leptin and TSH were highest on d 0, decreasing to nadir levels on d 61 ($P<0.01$). Milk serum IGF-1 was also highest on d 0 ($P=0.02$) and decreased to undetectable levels by d 12. Mare BCS was not detectably different between pre-and post-partum ($P=0.61$), while BW differed dramatically ($P<0.01$) due to parturition. During the 61 d interval that mares were studied post-partum neither BW nor BCS differed over time ($P>0.75$). As foals aged, ultrasonic fat depth and longissumus dorsi muscle area increased ($P<0.04$) as did BCS and BW ($P<0.01$).

Key Words: Horse, Leptin, IGF-1

455 Effect of parity and day on foal nursing behavior during the first month of lactation. T. N. Stamper*[2], B. D. Nielsen[1], J. Liesman[1], and N. L. Trottier[1], [1]*Michigan State University*, *East Lansing*, [2]*Grand-Valley State University*, *Grand-Rapids, MI*.

Arabian mares, three primiparous and three multiparous, were used to examine nursing behavior of foals. All nursing bouts and their duration were recorded for 24 h on d 9, 19 and 29 of lactation. A nursing bout was defined as any uninterrupted nursing interval lasting 27 sec or longer. Nursing frequency (number of nursing bouts per h), duration of a nursing bout, and total duration of nursing per h were averaged over the daytime (0830 to 1600) and nighttime (1600 to 0830) periods. Across parities, nursing frequency (bouts/h) was higher ($P \leq 0.01$) during the day time compared to that of night time (4.0, 3.2 and 3.1 vs 1.1, 1.0, and 0.9 on d 9, 19, and 29, respectively), and was lower ($P = 0.097$) in primiparous during day time on d 9 and 19 compared to multiparous mares (3.73 vs 4.36 and 2.67 vs 3.69 on d 9 and 19, respectively). Nursing frequency decreased with d of lactation in both primiparous and multiparous mares ($P \leq 0.05$ and $P = 0.08$, respectively) during day time only. Total duration of nursing per h (min/h) was higher during daytime compared to nighttime ($P \leq 0.001$) and decreased (linear, $P \leq 0.05$) with d of lactation in both primiparous and multiparous mares (3.74, 2.9, and 2.98 vs 4.12, 3.43, 2.81 for d 9, 19, and 29, respectively). Duration of a single nursing bout (min/bout) did not differ between day and nighttime, parities or d of lactation, and varied between 1.34 and 1.61 min. In conclusion, nursing frequency and total nursing duration per h declined with d of lactation during the daytime, and nursing frequency and total nursing duration per h were greater during the daytime compared to nighttime. The duration of a

single nursing bout was similar across time of day, d of lactation, and parity of mare. In conclusion, d of lactation, time of d and parity affect total nursing duration per h via changes in nursing frequency (bouts/h) rather than via changes in nursing duration per single bout. Thus, nursing frequency rather than duration of nursing per single bout appears to be the determinant of nutrient intake by foals.

Key Words: Foal, Nursing, Behavior

456 Effect of parity and day on nutrient intake by foals and nutrient demand on mares during the first month of lactation. T. N. Stamper[2], B. D. Nielsen[1], and N. L. Trottier*[1], [1]*Michigan State University*, *East Lansing*, [2]*Grand-Valley State University*, *Grand Rapids, MI*.

Arabian mares, three primiparous (P) and three multiparous (M), were used to estimate milk and nutrient intake by foals and nutrient demand on mares. Milk intake was estimated on d 10, 20 and 30 of lactation by weigh-suckle-weigh. Milk was collected on d 11, 21 and 31. Digestible energy (DE) requirements (Mcal/d) were estimated based on milk E content derived from milk lactose, protein and fat concentrations and a conversion coefficient (CC) of 0.72. Digestible protein (DP) requirements (g/d) were estimated based on daily true milk protein (TP) and a CC of 0.65. Data were analyzed as repeated measures over d of lactation and relationships between d of lactation and response variables determined by linear and quadratic orthogonal contrasts. Milk yield (kg) did not change with d of lactation in P mares but tended to increase in M mares (linear, $P = 0.12$) (12.98, 12.86, and 12.85 vs 12.66, 14.62, and 14.31 ± 1.43, respectively). As a percentage of BW, milk yield over d of lactation was 3.05 and 3.40 for P and M mares, respectively. Concentrations of TP decreased (linear, P = 0.05) and lactose and total solids increased (linear, P = 0.05 and P ≤ 0.001, respectively) in P mares, but did not change in M mares. Milk fat of M mares decreased (linear, $P \leq 0.05$) with d of lactation (3.2 to 1.7 %) but did not change in P mares (2.05 to 2.39 %). Fat and TP yield did not differ between parities, but lactose yield was higher ($P \leq 0.05$ on d 30) in M compared to P mares. Day of lactation increased (linear, $P \leq 0.01$) lactose yield in M mares. Estimates of DP (g/d) requirements in P mares decreased (linear, $P \leq 0.05$) with d of lactation (625, 579 and 503 for d 10, 20 and 30, respectively), but did not change in M mares (564, 527 and 633 for d 10, 20, and 30, respectively). Estimates of DE (Mcal/d) did not differ between P and M mares or between d of lactation (26.8, 26.3 and 27.2 vs 29.5, 30.0, and 31.8 ± 3.3, respectively). Results suggest that decreasing milk TP yield with d of lactation and lower milk lactose yield in P mares may limit foal protein and carbohydrate intake compared to that of M mares.

Key Words: Mare, Milk composition, Milk yield

457 Duration of nursing and resting bouts of foals ten and twenty days after birth. B. D. Nielsen*[1], T. N. Stamper[1], N. L. Trottier[1], J. S. Liesman[1], I. Gyorkos[2], L. Tecsy[2], A. Harcsa[2], and A. Tecsy[2], [1]*Michigan State University*, *East Lansing*, [2]*College of Nyiregyhaza*, *Nyiregyhaza, Hungary*.

The objective of this study was to determine the frequency and duration of nursing bouts in foals. This information is essential in order to estimate nutrient intake of foals and nutrient demands on nursing mares. Seven foals out of Hungarian sport half-breed (primarily Thoroughbred breeding) mares (5 to 15 yr of age) and by Holstein, French and Dutch stallions were used in this study that was conducted at the Demonstration Farm of the College of Nyiregyhaza, Napkor, Hungary. Horses were housed in box stalls ranging in size from 10.5 to 15 m^2. Horses were fed approximately 8 kg of a mixture of grass and alfalfa hay, and 4 to 6 kg of corn and crimped oats. Mares and foals were observed for a 24–h period on d 10 and 20 after foaling. Length of time spent nursing and the number of times a foal nursed, as defined as any suckling attempt lasting longer then 27 seconds, were recorded. Additionally, the length of time foals spent lying on the ground resting was recorded. Data were analyzed as repeated measures with hour of day within foal and day of lactation being the repeated variable. Nursing bouts per hour decreased from 3.85 ± 0.21 on d 10 to 2.85 ± 0.21 on d 20 ($P < 0.02$). The average duration of the nursing bouts was 1.22 ± 0.05 min on d 10 and 1.11 ± 0.05 min on d 20 ($P = 0.15$) resulting in a decrease ($P < 0.03$) in average time spent nursing per h from 4.67 ± 0.34 min/h on d 10 to 3.18 ± 0.34 min/h on d 20. In contrast, time resting remained unchanged with an average of 28.7 ± 1.1 min/h spent resting on d 10 as compared to 27.8 ± 1.1 min/h on d 20. The greatest number of nursing bouts/h and the longest time nursing within an hour were observed from 0600 to 0659 while the lowest were from 0300 to 0359. The second greatest number of nursing bouts and time nursing within an hour was from 1600 to 1659. The duration of resting periods was reduced when nursing activity was greatest and corresponded to the time when mares were being fed. This study demonstrates there are changes in duration and frequency of nursing bouts of young foals during a 24–h period and across days of lactation that must be considered when estimating milk production and consumption.

Key Words: Foal, Nursing, Rest

458 Effect of dietary n-3 fatty acid supplementation on plasma and milk composition and immune status of mares and foals. E. L. Stelzleni*, L. K. Warren, and J. Kivipelto, *University of Florida*, *Gainesville*.

To determine the effects of dietary n-3 fatty acid (FA) supplementation on plasma and milk FA composition and immune function, 36 Thoroughbred and Quarter Horse mares were randomly assigned to one of three treatments from 28 d pre-partum to 84 d post-partum: encapsulated fish oil (FISH, n=12); milled flaxseed (FLAX, n=12); or no supplementation (CON, n=12). FISH contained 15 g eicosapentaenoic acid (EPA) and 12.5 g docosahexaenoic acid (DHA) per 100 g fat. FLAX contained 61 g α-linolenic acid (ALA) per 100 g fat. Mares had free access to coastal bermudagrass hay and bahiagrass pasture and were individually fed a grain mix concentrate (4% crude fat) at 1.5% of BW/d. FISH and FLAX were mixed into the concentrate in amounts to provide 6 g total n-3/100 kg BW. Blood samples were obtained from mares at 28 d pre-partum and milk and blood samples were obtained from mares and foals at foaling, 36 h and 14, 28, 56 and 84 d post-partum and analyzed for FA and IgG content. On d 84, mares and foals received paired intradermal injections of phytohemagglutinin (PHA) and skin thickness was determined over 48 h as a measure of cell-mediated immune response. Body weight of mares and foals was not affected by treatment. Mares fed FLAX had higher plasma ALA (P=0.06). Mares fed FISH had higher plasma EPA, DHA and total n-3 (P=0.03). Across treatments, total n-3 increased (P=0.005) and total n-6 decreased (P=0.001) in milk from foaling to d 84. Milk from FLAX mares had higher ALA (P=0.01) and a lower n-6:n-3 ratio (P=0.007). Milk from FISH mares had higher EPA and DHA (P=0.001). Foals suckling FLAX mares had higher plasma ALA (P=0.04). Foals suckling FISH mares had higher plasma EPA, DHA and total n-3 (P=0.03) and a lower plasma n-6:n-3 ratio (P=0.002). Colostrum from mares fed FISH had lower IgG (P=0.02), but milk

and foal serum IgG were not affected by treatment. Response to PHA injection was greater (P=0.0001) in mares compared to foals, but similar between treatments. Although the addition of n-3 FA to the mare's diet altered the FA content of milk and mare and foal plasma, changes in immune response were not detected.

Key Words: Omega-3 fatty acids, Immune response, Horse

459 Effects of dietary fish oil and flaxseed on plasma fatty acid composition and immune response in yearling horses. K. R. Vineyard*[1], L. K. Warren[1], K. A. Skjolaas[2], J. E. Minton[2], and J. Kivipelto[1], [1]*University of Florida*, *Gainesville*, [2]*Kansas State University*, *Manhattan*.

To determine the effects of different sources of dietary n-3 fatty acids on plasma FA composition and immune response in yearling horses, 18 Quarter Horse yearlings were randomly assigned to one of three treatments: encapsulated fish oil (FISH, n=6), milled flaxseed (FLAX, n=6), or no supplementation (CON, n=6). FISH contained 15 g eicosapentaenoic acid (EPA) and 12.5 g docosahexaenoic acid (DHA) and FLAX contained 61 g ∝-linolenic acid (ALA) per 100 g fat. Horses had free access to bahiagrass pasture and were individually fed a grain mix concentrate at 1.5% BW/d. FISH and FLAX were mixed into the concentrate in amounts to provide 6 g total n-3/100 kg BW. Horses were fed their respective treatments for 70 d. Blood samples were obtained at 0, 35 and 70 d for determination of plasma FA and isolation of peripheral blood mononuclear cells (PBMC). PBMC were stimulated with Concanavalin A and phytohemagglutinin (PHA) for determination of lymphocyte proliferation (LP). PBMC collected on d 70 were also challenged with lipopolysaccharide (LPS) to determine PGE_2 production. On d 70, horses were injected intradermally with PHA, and skin thickness and area of swelling were evaluated over a 48 h period to assess *in vivo* inflammatory response. Treatment did not affect body weight gain (mean±SE, 41.8±1.9 kg). Horses fed FISH had higher (P<0.05) plasma EPA, DHA and total n-3 and lower (P<0.05) plasma linoleic acid, ALA and n-6:n-3 FA ratio than FLAX and CON. PBMC positively responded to mitogen stimulation and PGE_2 increased in response to LPS, but treatment did not affect LP or PGE_2 production. Across treatments, peak increase in skin thickness was observed between 4 h and 6 h after PHA injection. At 4 h post injection, FISH and FLAX had a greater increase in skin thickness than CON (P<0.05) and FISH had a larger area of swelling than CON at 4 h and 12 h (P<0.05). Although fed to supply a similar level of n-3 FA, FISH had a greater impact on plasma n-3 FA and n-6:n-3 ratio than FLAX. However, both FISH and FLAX demonstrated a more pronounced early inflammatory response to PHA injection than unsupplemented horses.

Key Words: Omega-3 fatty acids, Immune response, Equine

460 Effects of fatty acid supplementation on plasma fatty acid concentrations and characteristics of the first postpartum estrous in mares. T. A. Poland*[1], J. M. Kouba[1], C. M. Hill[1], C. Armendariz[1], J. E. Minton[1], and S. K. Webel[2], [1]*Kansas State University*, *Manhattan*, [2]*JBS United, Inc.*, *Sheridan, IN*.

Fat supplementation of horse diets has traditionally utilized sources rich in n-6 fatty acids. The objective of this study was to evaluate the effects of supplementing mares with protected marine-derived n-3 fatty acids (JBS United) during late gestation and early lactation. Twenty Quarter-type mares were randomly assigned to one of three treatment groups. Beginning 60 d prior to the expected foaling date, mares were fed either a control diet (CON, concentrate base with added corn oil, n=6), a docosahexaenoic acid (DHA) supplemented diet (D, n=7), or a eicosapentaenoic acid (EPA) / DHA supplemented diet (ED, n=7). Diets continued after parturition through the first postpartum estrous cycle. Mare plasma was collected at the start of treatment, at parturition, and at wk 3 postpartum. Gas chromatography was used to analyze mare plasma for linoleic acid (LA), arachidonic acid (AA), alpha-linolenic acid (ALA), EPA, and DHA. Gestation length did not differ between treatment groups. The time from foaling to the first postpartum ovulation was increased (P<0.01) in the ED group (22.5±2.1 d) compared to both the CON (12.5±2.3 d) and D (13.3±2.3 d) groups. The length of time that mares in the ED group held a large (≥ 35 mm) follicle during the first postpartum estrous period was increased (P<0.05, 12.7±1.9 d) compared to the CON (6.3±2.0 d) or D (6.0±2.0 d) groups. Mare plasma LA and ALA concentrations were not affected by treatment. AA was elevated (P<0.05) in D mares at parturition and 3 wk postpartum compared to the CON mares. DHA was increased (P<0.01) in both the ED and D mares at parturition and 3 wk postpartum compared to the CON group. EPA was increased (P<0.01) in ED mares at parturition and 3 wk postpartum compared to both the D and CON mares. Feeding mares diets high in EPA may result in increased follicle retention and affect timing of ovulation in the early postpartum period.

Key Words: Mare, n-3 fatty acids, Follicle

Nonruminant Nutrition: Sow Nutrition and Gilt Development

461 Determining the threonine requirement of the lactating sow. J. D. Schneider*, M. D. Tokach, S. S. Dritz, R. D. Goodband, J. L. Nelssen, and J. M. DeRouchey, *Kansas State University*, *Manhattan*.

A total of 182 lactating sows were used to determine the optimal threonine:lysine ratio, and the relative difference in performance of diets with high levels of crystalline amino acids compared to a corn-soybean meal diet. All experimental diets were corn-soybean meal-based and formulated to contain 0.88% true ileal digestible (TID) lysine (1.00 and 0.97% total lysine for the control and crystalline amino acid diets, respectively). Diets were formulated to be below the expected lysine requirement of the sows based on modeled performance of previous farrowing groups. The control diet contained no added crystalline amino acids, whereas the five other diets contained 0.37% L-lysine HCl with other amino acids added to ensure threonine was first limiting. The TID threonine levels in these diets were formulated to 0.44, 0.50, 0.57, 0.64, and 0.70%. Sows were randomly allotted to the dietary treatments based on parity. Over the entire lactation period, sows fed the diets containing crystalline amino acids consumed more (P < 0.04) feed than the sows fed the control corn-soybean meal diet (5.5 vs 5.1 kg, respectively). Sows fed the control diet lost numerically (P > 0.10) more weight (15.1 vs 12.9 kg) over the lactation period and had higher (P < 0.01) PUN on d 18 of lactation than sows fed diets