

TA, water-soluble Ca and P, and significantly lower salt, pH and total Ca. The data suggest that within-vat variation in salting efficacy may have influenced calcium lactate crystal formation. Lower salt uptake by Cry+ cheese curd during salting may have resulted in higher moisture (and thus lactose) retention, which caused more lactic acid to be produced in the cheese. Higher lactic acid resulted in lower pH, which shifted calcium to the soluble state. Lactate and soluble Ca in Cry+ cheese became further elevated at the cheese surface as a result of dehydration during natural smoking, possibly triggering the formation of calcium lactate crystals.

Key Words: Cheddar, Calcium Lactate, Crystals

63 Influence of calcium, phosphorus, residual lactose, and salt-to-moisture ratio on cheese quality: pH changes during ripening. P. Upreti*, P. S. Lehtola, and L. E. Metzger, *Department of Food Science and Nutrition, MN-SD Dairy Food Research Center, University of Minnesota, St. Paul.*

The pH of cheese is an important attribute that influences its quality. Large changes in cheese pH are often observed during ripening. Changes in cheese pH during early ripening are associated with calcium (Ca), phosphorus (P), residual lactose, and salt-to-moisture ratio (S/M) of the cheese. Ca and P have the ability to act as a buffer that stabilizes cheese pH, whereas lactose is converted to lactic acid that causes a decrease in cheese pH. The S/M can influence bacterial growth that can affect the rate of conversion of lactose to lactic acid. The net balance between the buffering capacity and the formation of lactic acid should, therefore, determine cheese pH. In order to assess this hypothesis, 4 treatments of Cheddar cheese with 2 levels (high and low) of calcium (Ca) and phosphorus (P), and 2 levels (high and low) of residual lactose were manufactured. Each treatment was subsequently split in half and salted at 2 levels (high and low) for a total of 8 treatments. The detailed experimental design and manufacture of these cheeses is a subject of another abstract submitted for this conference. All the cheeses were salted at a pH of 5.4, pressed for 5h, and then ripened at 6-8°C. The pH of the salted curds before pressing, cheese at day 1, and weeks 1, 2, 3, and 4 of ripening was measured. The cheeses with low levels of Ca and P, high lactose, and low S/M showed a considerable drop in pH (mean=0.20 units) from salting to d1 of ripening, whereas, cheeses with high levels of Ca and P, low lactose, and high S/M showed an average drop in pH of 0.07 units. The comparison of pH of cheeses at 4wk indicated that cheeses with higher levels of Ca and P had higher pH ($p<0.05$) as compared to lower Ca and P cheeses. Also, cheeses with higher S/M were

higher in pH ($p<0.05$) as compared to lower S/M cheeses. Residual lactose content of cheeses had a significant effect ($p<0.05$) on cheeses at low salt content. However, at high salt content the effect of residual lactose was not significant. This study determined that changes in cheese pH during early ripening were influenced by Ca and P, lactose, and S/M.

64 Effect of starter inoculation rates and incubation temperatures on physical properties of yogurt. W. J. Lee* and J. A. Lucey, *Department of Food Science, University of Wisconsin, Madison.*

Textural attributes are considered as important criteria for the quality of yogurt. The objectives of this research were to investigate the effect of different starter culture inoculation rates and incubation temperatures on physical properties and microstructure of yogurt gels. A two factor (5×2) experimental design was used for data analysis. Yogurt gels were made with 0.5, 1, 2, 3, or 4% (w/w) inoculation rates and incubated at 40 or 46°C. Dynamic low amplitude oscillatory rheology was performed to monitor rheological properties of yogurt gels. Gel permeability and amount of surface whey were determined. Confocal scanning laser microscopy was used to examine gel structure. Storage modulus values (stiffness) increased with increased inoculation rate and decreased incubation temperature. Gels made at higher inoculation rate and incubation temperature exhibited higher yield stress and had higher loss tangent values (ratio of viscous to elastic moduli) during gelation, respectively. Higher permeability and whey separation values were observed in yogurt gels made at lower inoculation rate and higher incubation temperature, which indicated an increased susceptibility of the network to rearrange. These rearrangements resulted in the formation of large pores in gel network. An increase in inoculation rate resulted in a decrease in the pH where the maximum in loss tangent occurred, presumably reflecting less efficient solubilization of colloidal calcium phosphate (which is a slow process) and the need to attain a lower pH to complete the solubilization. Whey separation was positively correlated with the value for maximum in loss tangent ($r = 0.94$) and permeability ($r = 0.89$), respectively. A negative correlation was observed between whey separation and storage modulus ($r = -0.48$). It was concluded that rearrangements of casein particles in gel network and pH at which the solubilization of colloidal calcium phosphate occurred were important driving forces involved in whey separation and a weak network.

Key Words: Yogurt, Rheology, Starter Culture

National ADSA Production Only (Graduate)

65 Cloning the genomic sequence and proximal promoter of bovine pyruvate carboxylase. S. M. Rodriguez*, C. A. Bidwell, and S. S. Donkin, *Purdue University, West Lafayette, IN.*

Pyruvate carboxylase (PC) catalyzes a pivotal reaction in gluconeogenesis and lipid metabolism in liver. We previously identified six unique alternative splice variants in the 5 untranslated region (UTR) of PC mRNA. These splice variants may have a role in translational regulation of PC protein abundance. The objectives of this experiment were to clone and sequence the bovine PC gene, to determine the intron/exon organization of the 5UTR and to identify PC promoter elements. The RPCI-42 Bovine Bacterial Artificial Chromosome (BAC) library was screened with oligonucleotide sequences corresponding to specific elements of the 5 UTR sequence of bovine PC and to a region of the coding sequence. Two BACs that hybridized to all probes were selected for further analysis. A partial restriction map of the BACs was made with oligonucleotides corresponding to the coding region and the 89 and 110 bp elements of bovine PC 5 UTR. The BAC fragments that hybridized to the oligonucleotide probes were isolated and sequenced. The sizes of the cloned genomic PC 5 UTR fragments were verified by PCR, using genomic DNA from four cows. Sequencing data confirms the existence of a 178 bp exon that contains the 68 and 110 bp sequence elements of the 5 UTR for PC mRNA. The 178 bp exon appears to be the first transcribed exon in PC and the 68 and 110 bp 5 UTR sequences are most likely generated by alternative transcription start sites. Genomic sequence data also confirms that the 3 end of the 89 bp element is a discrete 41 bp exon. Regions within the genomic sequence adjacent to the 178 and 41 bp exons of the PC 5 UTR contain binding sites for TBP, Sp1, Ap1 and/or CEBP transcription factors. These data provide

information about the arrangement of exons in the 5 UTR of PC and about putative promoter regions.

Key Words: Pyruvate Carboxylase Gene, Liver, Promoter

66 Relationship between antibiotic susceptibility of mastitis pathogens and treatment outcomes. F. Hoe* and P. Ruegg, *University of Wisconsin, Madison.*

Antimicrobial susceptibility testing is commonly used to guide mastitis treatments. Broth microdilution is used to obtain quantitative results that are recorded as minimum inhibitory concentrations (MIC). The objective of this study was to determine the relationship between MIC values of mastitis pathogens and clinical outcomes. Duplicate quarter milk samples were obtained from cows observed with mild to moderate mastitis in a single quarter. Cows were ineligible if they had secondary clinical signs or had received antibiotics within the previous 30 days. Cows were treated with intramammary penicillin and could not receive ancillary treatments. Milk samples were collected before treatment and 14 and 21 days after treatment. Microbiological procedures were as described by the NMC. MIC values were determined using a commercial microdilution method (Sensititre, Westlake, OH). Of eligible milk samples ($n = 217$), 58 samples were no growth, 17 produced different growth on the duplicates and 6 were contaminated. MICs were obtained for: *Strep* spp. (34.6%); *E.coli* (25.7%); CNS (19.1%); *Klebsiella* spp. (9.6%) and other minor pathogens (14.0%). No significant difference was observed for days of treatment (2.8 and 2.9) and days until clinical cure (3.5 and 3.8) for gram positive and gram negative isolates, respectively

($P > 0.09$). No significant difference was observed for days of treatment (2.8 and 2.9) and days until clinical cure (3.4 and 3.8) for isolates that were susceptible or resistant to pirlimycin, respectively ($P > 0.9$). No significant differences in bacteriological cures were observed for gram positive (40.9% and 50.7%) and gram negative (50% and 50.9%) isolates, at day 14 and 21, respectively ($P > 0.8$). No significant differences in bacteriological cures were observed at day 14 (41.2% and 47.8%) or day 21 (50.9% and 50.7%) for susceptible or resistant isolates, respectively ($P > 0.7$). There was no association between farm and mean MIC for any antibiotic included in the mastitis susceptibility panel. This study did not identify an association between results of susceptibility testing and clinical outcomes of mastitis.

Key Words: Mastitis, Treatment, Susceptibility

67 Effect of selection for milk yield on hepatic prolactin receptor (PRLR) mRNA in Holstein cows. M. Carriquiry*, S. H. Wu, W. J. Weber, H. Chester-Jones, L. B. Hansen, and B. A. Crooker, *University of Minnesota, St. Paul.*

Prolactin participates in regulation of liver metabolic function, promotion of hepatocyte proliferation, and induction of growth related gene expression. Cows from control (stable milk yield since 1964; C) and select (S) genetic lines that differed in milk yield by more than 4,500 kg/305 d in milk (DIM) were used to evaluate effects of selection on hepatic mRNA for long (L-PRLR) and short (S-PRLR) isoforms of PRLR. Lines were fed ad libitum and exposed to the same environment. Multiparous (CM, SM) and primiparous (CP, SP) cows ($n = 8$ per line \times parity) blocked by calving date were biopsied at -12, 20, and 68 DIM. Hepatic RNA was isolated and L-PRLR and S-PRLR mRNA determined by real-time PCR. The same forward primer (5'-GCAGTGGCTTTGAAGGGCTATA-3') was used for each isoform. The reverse primer (5'-ACAAGGCGAGAAGGCTGTGATAT-3') for S-PRLR bound within the 39 bp insert specific for the S-PRLR isoform while the L-PRLR reverse primer (5'-GACTTGCCTTCTCCAGCAGAT-3') spanned the point (nucleotide 942) of this insert. Gene expression relative to hypoxanthine phosphoribosyltransferase (HPRT) was reported as relative units (ru). Results from a repeated measures analysis (PROC MIXED of SAS) differed when $P < 0.05$. Milk yields of CP, CM, SP, and SM cows were 18.6, 29.1, 29.6, and 48.6 kg/d. HPRT decreased as DIM increased primarily due to a lower expression in SP and CP at 68 DIM. L-PRLR (8.00b, 15.28a, 14.77a \pm 1.28 ru) and S-PRLR (5.24b, 8.07a, 8.45a \pm 0.72 ru) were less at -12 than at 20 or 68 DIM. There was a line by parity interaction for L-PRLR as mRNA in SM was greater than SP, CM and CP cows (21.00a, 11.57b, 8.82b, 9.35b \pm 1.85 ru). Select cows had more mRNA for L-PRLR (16.28, 9.08 \pm 1.31 ru) and S-PRLR (8.64, 5.87 \pm 0.74 ru) than control cows. The ratio L-PRLR to S-PRLR did not differ by DIM for control (1.88, 1.60, 1.55 \pm 0.16) but increased in select cows postpartum (1.46a, 2.12b, 1.95b \pm 0.16). Data suggest liver expression of L-PRLR is associated with increased milk yield.

Key Words: Genetic Selection, Liver, Prolactin Receptor

68 Exposure to short day photoperiod enhances mammary growth during the dry period of dairy cows. E. H. Wall*¹, T. L. Auchtung², G. E. Dahl², and T. B. McFadden¹, ¹University of Vermont, Burlington, ²University of Illinois, Urbana.

Exposure to short day photoperiod (SDPP; 8h light:16h dark) during the dry period increases milk yield of cows in the subsequent lactation. We hypothesized that this effect is due to increased growth of mammary epithelial cells in response to enhanced prolactin signaling converging on the IGF axis. Multiparous Holstein cows were dried off 62 days before parturition and assigned to long day (LDPP; 16h light:8h dark) or SDPP during the dry period. Mammary biopsies were obtained at -40, -20, -7 and +7 days relative to calving ($n=6$ cows/treatment) and rates of [³H]-thymidine incorporation into DNA *in vitro* were quantified. IGF-1, -2, and IGFBP-5 mRNA expression was assessed by real time RT-PCR. The mixed procedure of SAS was used for statistical analysis. For both treatments, cell proliferation rate increased from 40d to 7d ($P < .01$), then decreased in lactation ($P < .001$). However, timing of the proliferative response differed between treatments ($P < .05$). Proliferation rate increased from 40d to 20d in SDPP cows ($P < .01$) and was higher than LDPP cows at 20d ($P < .01$). The increase in proliferation did not occur until -7d for LDPP cows ($P < .01$). IGF-2 expression increased at -7d for SDPP cows ($P < .05$) and remained high in lactation, but did not increase in LDPP cows until after parturition ($P < .05$). IGFBP-5 mRNA

increased during lactation in both groups ($P < .05$) but was higher overall in LDPP cows vs. SDPP cows ($P < .05$). Expression of IGF-1 did not differ over time or between treatments. We conclude that exposure to SDPP during the dry period elicits earlier mammary cell proliferation relative to LDPP. Despite the lack of treatment difference in IGF-1 expression, lower IGFBP-5 expression in SDPP cows may increase IGF-1 availability to support mammary cell growth and survival. Temporal differences between treatments suggest the existence of a critical window wherein photoperiod affects mammary gland development during the dry period.

Key Words: Photoperiod, Mammary Growth, Prolactin Axis

69 Nutrient status influences the effect of conjugated linoleic acid on milk synthesis. M. J. de Veth*¹, E. Castaneda-Gutierrez¹, D. A. Dwyer¹, A. M. Pfeiffer², D. E. Putnam³, and D. E. Bauman¹, ¹Cornell University, Ithaca, NY, ²BASF-AG, Ofenbach, Germany, ³Balchem Encapsulates, New Hampton, NY.

The *trans*-10, *cis*-12 conjugated linoleic acid (CLA) isomer inhibits milk fat synthesis, whilst milk yield and synthesis of other milk components generally remains unchanged in cows in established lactation. However, in some CLA studies increases in milk yield and/or milk protein yield have been observed in cows limited in energy, either in early lactation or when fed pasture. Our objective was to evaluate the milk response to CLA when cows were provided limited dietary energy in combination with adequate or excess protein. Holstein cows ($n = 48$ mid-lactation) were fed ad-lib a TMR diet that met energy and protein requirements for a 16-d adjustment interval. Based on performance during this interval, the Cornell Net Carbohydrate and Protein System (CNCPS) model was used to design an energy-limiting ration that provided 80% of metabolizable energy requirement, which was fed to the experimental cows throughout the treatment periods. Cows were randomly allocated to four treatments (2 \times 2 factorial), in a 2 period crossover design. Treatments were: 1) protein adequate ration (PAR), 2) PAR + CLA, 3) protein excess ration (PER), and 4) PER + CLA. PAR and PER were set at 88% and 117%, respectively, of the metabolizable protein requirement established during the 16-d adjustment interval as estimated by the CNCPS model. Each experimental period comprised 16-d, with crossover of CLA within each level of protein. The dietary supplement of CLA was a lipid-encapsulated form that provided 12 g/d *trans*-10, *cis*-12 CLA. Milk samples were collected on the last 5d of each period. CLA treatment reduced milk fat yield (20.8%, $P < 0.01$), but increased both milk yield and milk protein yield (2.5% and 2.8%, respectively; $P < 0.05$). Milk yield, content and yield of both milk protein and milk fat were unaltered by either protein treatment alone or in combination with CLA. Overall, results demonstrate that CLA supplementation when cows are energy-limited may allow for increases in yield of milk and milk protein, and this may occur without the need for additional dietary protein.

Key Words: Conjugated Linoleic Acid, Milk Fat Depression, Milk Protein

70 Effect of transition diet on metabolism of Holstein cows in the periparturient period. J. Guo*, R. Peters, E. Russek-Cohen, and R. Kohn, *University of Maryland, College Park.*

The objectives were to characterize the homeorhetic change in blood metabolites and to evaluate the effect of transition diet on ketone body accumulation in periparturient cows. Twenty-eight multiparous Holstein cows were listed in order of their anticipated due dates and assigned to one of two groups with or without transition diet. The cows in treatment group received a transition diet (1.67 Mcal/kg NEL, 17% CP, 31% NDF) from 14 d before expected parturition to 14 d after calving and were fed the same diets as the cows in control group during the rest of experiment period. The cows in control group received a dry diet (1.38 Mcal/kg NEL, 11% CP, 53% NDF) from 28 d before expected due date, and a lactation diet (1.72 Mcal/kg NEL, 17% CP, 26% NDF) after parturition. Blood from coccygeal vein was sampled three times per week from 21 d before expected parturition to 21 d postpartum for analysis of glucose, non-esterified fatty acid (NEFA), β -hydroxybutyrate (BHBA), acetoacetate (ACAC), acetone, and glycerol. Plasma levels of ketone bodies changed in parallel, after parturition ketone bodies peaked at d 7 postpartum, and then decreased but remained high compared to values during the dry period. Plasma levels of NEFA and glycerol peaked at d 3 postpartum and changed in a similar pattern to those of ketone

bodies. Plasma glucose concentrations were higher for cows fed the transition diet compared with control cows in the last week prepartum (65.2 vs 55.1 mg/dl $P < 0.01$). Areas under the curve across the first 21 days postpartum for ACAC, NEFA, and glycerol were greater for cows receiving transition diets than for control cows ($P < 0.05$). There were no significant differences ($P > 0.05$) in peak plasma concentration (Cmax) and time of its occurrence (Tmax) between the treatment and control groups for glucose, NEFA, glycerol, acetone, ACAC, and BHBA. Results indicate that plasma glycerol may be an important contributor to gluconeogenesis during the periparturient period. Feeding a transition diet had a negative impact on postpartum metabolic variables.

Key Words: Transition Diet, Ketone Bodies, Fat Mobilization

71 The effect of copper supplementation and breed on milk fatty acid profile. J. Sumner^{*1} and P. French², ¹Washington State University, Pullman, ²Oregon State University, Corvallis.

An experiment was conducted to determine the effect of dietary copper (Cu) on Cu status and lipid metabolism in Holstein and Jersey cattle. Eight Jersey and 8 Holstein cows in mid-lactation (169 ± 37) were blocked by days in milk and assigned at random to one of two diets. Cows received either a control diet (Cu-) which contained a basal level of 8 mg Cu/kg DM or a treatment (Cu+) diet that was supplemented with 16 mg Cu/kg DM from CuSO₄ for a total of 24 mg Cu/kg DM. As expected, DM intake and milk yield were greater for Holsteins and milk fat and protein percentages were greater for Jerseys. Plasma Cu was greater for Jerseys and hepatic Cu was greater at 90 days of treatment for Cu+ Jerseys compared to Cu+ Holsteins. Total C18:0 in milk was lower for both Cu+ treatment groups. On day 90 of treatment, conjugated linoleic acid (CLA) in milk was less for Cu+ compared to Cu-. Also on treatment day 90, Cu+ cows produced more total saturated fatty acids than Cu- cows for both breeds. These results indicate that Cu metabolism differs between these two breeds. In addition, Cu supplementation decreased CLA secretion possibly due to an effect on biohydrogenation in the rumen or stearyl coenzyme A desaturase, an enzyme involved in the production of CLA.

Key Words: Copper, CLA

72 Evaluation of the ability of dietary fish oil to maintain elevated conjugated linoleic acid (CLA) in milk from dairy cows through five months of lactation. M. T. Sands*, S. T. Franklin, J. A. Jackson, L. J. Driedger, and K. I. Meek, University of Kentucky, Lexington.

Most trials for enhancement of milk CLA by dietary means have been short-term. The objective of this study was to determine the long-term ability of dietary Menhaden fish oil to maintain elevated CLA in milk fat of dairy cows. Nine primiparous cows (3 Jersey and 6 Holstein) and 12 multiparous cows (3 Jersey and 9 Holstein) were blocked by breed and parity and assigned to dietary treatments. Lactating diets were 1) control (CON), 2) cottonseed (CS), or 3) fish oil (FO) at 1.5% of dry matter (DM). During the dry period, cows assigned to the CON and CS diets were fed a dry cow control diet (DCON) and cows assigned to the FO diet were fed a dry cow diet containing 0.5% FO (DFO). Cows were housed in a free stall barn with Calan head gates approximately 4 wk prepartum to allow for 1 wk of acclimation and 3 wk of data collection. Postpartum feed intake and milk yields were recorded daily. Weekly milk samples were analyzed for fat, protein, and somatic cell count (SCC). Milk was sampled weekly for the first 2 wk and then biweekly for fatty acid analysis. Body condition scores (BCS) were estimated monthly and cows were weighed weekly throughout the trial. Serum was collected weekly through wk 4, then biweekly for analysis of nonesterified fatty acids (NEFA) and β -hydroxybutyrate (BHBA). Cows fed CON consumed more ($P < 0.05$) DM compared with cows fed CS and FO diets (21.6 ± 1.5 , 17.5 ± 1.5 , and 15.4 ± 1.5 kg/d respectively). Milk and protein yield were not affected ($P > 0.05$) by diet but fat yield was lower for cows fed FO. Both CLA and TVA were elevated ($P < 0.05$) in milk from cows fed FO compared with milk from cows fed CON or CS. Mean CLA content was $1.9 \pm 0.1\%$ in milk from cows fed FO compared with $0.6 \pm 0.1\%$ in milk from cows fed CON and CS. Dry cow DM intake, NEFA, BHBA, body weight, BCS and SCC were not affected by diet. Results indicate that cows fed FO at 1.5% of DM through 5 mo of lactation were able to maintain elevated concentrations of CLA and TVA

without adverse effects on serum NEFA, serum BHBA, body weight, or BCS.

Key Words: Fish Oil, Conjugated Linoleic Acid, Dairy

73 Effects of dietary CLA on production parameters in pasture-fed transition dairy cows. J. K. Kay^{*1,2}, J. R. Roche^{2,3}, and L. H. Baumgard^{1,3}, ¹University of Arizona, Tucson, ²Dexel, New Zealand.

High dietary CLA doses inhibit milk fat synthesis in TMR-fed dairy cows by wk 2 of lactation, however, CLA effects on pasture-fed cows immediately post-partum have not been investigated. Multiparous Holstein cows ($n=39$) grazing pasture were randomly assigned to one of three treatments: 1) pasture (PAS), 2) PAS + 600 g/d rumen protected (RP) CLA (RP-CLA) and 3) PAS + 540 g/d Hyprofat (RP palm oil; HF). RP-CLA and HF treatments were isoenergetic, fed 2x/d and provided 197 and 0 g CLA/d, respectively. Treatments began 14-21 d pre-partum and continued until 36 DIM. Milk was sampled on d 1, 2, 3 and 4 post-partum and every third d (± 1) until d 36, and fatty acid composition was determined on d 4, 8 and 15 (± 2). There was no overall RP-CLA effect on protein content (3.78%) or protein or lactose yield, however RP-CLA increased ($P < 0.01$) overall milk lactose content (4.90%) compared to HF (4.75%), but did not differ from PAS (4.82%). RP-CLA reduced ($P < 0.05$) milk fat content by 6 DIM (4.16, 5.69 and 4.98% for RP-CLA, PAS and HF, respectively) and continued to inhibit milk fat synthesis as DIM progressed, with maximum ($\sim 40\%$) milk fat depression (MFD) occurring by d 21. Milk fat yield followed a similar temporal pattern although differences did not occur until d 15. There was no overall treatment effect on milk yield (20.3 kg/d), however a quadratic relationship ($R^2=0.6$) was detected between the RP-CLA induced milk yield response and extent of MFD in RP-CLA vs. HF. RP-CLA tended to increase milk yield (1.5 kg/d; $P=0.08$) until MFD exceeded 30%, after which point the increase in milk yield declined. Milk fat *trans*-10, *cis*-12 CLA content averaged 2.4 mg/g in the RP-CLA treatment, was undetectable in PAS and HF treatments and did not differ over time. RP-CLA did not affect the Δ^9 -desaturase system nor did it alter the origin of fatty acids (*de novo* vs. preformed; molar basis) until d 15. These data indicate a high RP-CLA dose decreases milk fat synthesis and tends to increase milk yield immediately post-partum in pasture-fed cows, however excessive MFD ($>30\%$) is associated with a diminished milk yield response.

Key Words: CLA, Pasture, Transition Period

74 Effect of feeding Ca salts of palm oil (PO) or of a blend of linoleic and monoenoic trans fatty acids (LTFA) on lactation and health of Holstein cows. S. O. Juchem^{*1}, R. L. A. Cerri¹, M. Villasenor¹, K. N. Galvao¹, R. G. S. Bruno¹, H. M. Rutigliano¹, A. C. Coscioni¹, E. J. DePeters¹, W. W. Thatcher², D. Luchini³, and J. E. P. Santos¹, ¹University of California, Davis, ²University of Florida, Gainesville, ³Bioproducts, Inc., Fairlawn, OH.

Holstein cows, 511, were blocked according to parity, BCS at dry off and previous lactation milk production and randomly assigned to receive (2% diet DM) either Ca salts of PO or LTFA from 23 d prepartum to 70 d in milk (DIM). Yields of milk and milk components were measured weekly, and BCS was evaluated at -43, -23, calving, and at 40, 70, 100 and 140 DIM. Blood was sampled weekly from 23 d prepartum to 21 DIM, and plasma was analyzed for glucose, NEFA and BHBA. Fatty acid profile in milk fat was analyzed at 2 and 10 wk postpartum in 30 cows/treatment. Disease incidence was recorded for individual cows. Continuous and binomial data were analyzed by the MIXED and LOGISTIC procedures of the SAS (2001), respectively. Interval from calving to an event (death, culled, disease) was analyzed by the LIFETEST procedure of SAS (2001). Yields of milk were similar for LTFA and PO (38.4 vs 38.9 kg/d; $P=0.32$). However, feeding LTFA reduced 3.5% fat-corrected milk (36.8 vs 39.1 kg/d) because of a decrease in milk fat % (3.3 vs 3.6%; $P < 0.05$) resulting in lower milk fat yield (1.24 vs 1.37 kg/d; $P < 0.01$). The negative effect on milk fat was observed after the second week of lactation. Milk protein % was increased by feeding LTFA (2.78 vs 2.74; $P < 0.01$), but milk protein yield (1.06 vs 1.06 kg/d) and SCC were similar ($P > 0.15$). Feeding LTFA increased ($P < 0.01$) the concentrations of linoleic acid (3.56 vs 2.83%), C18:1 trans 10 (1.0 vs 0.4 %), C18:1 trans 11 (1.5 vs 1.0%) and CLA cis 9, trans 11 (0.8 vs 0.5%) in milk fat on week 10 postpartum, but differences were already detected at wk 2 postpartum. BCS did not differ ($P > 0.15$) between LTFA and PO

at -43d (3.77 vs 3.80), calving (3.68 vs 3.67), 100 DIM (2.78 vs 2.79). Feeding LTFA compared to PO had no effect on incidence of clinical ketosis (8.2 vs 6.9%), displacement abomasum (3.1 vs 1.6%), and milk fever (1.9 vs 2.0%). Cows fed LTFA had reduced yields of fat and 3.5%

FCM, altered milk fatty acid profile, but changes in FCM yield did not reflect in positive effects on BCS or health.

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Key Words: Fatty Acids, Dairy Cows, Trans Fatty Acids

Horse Species

75 Insulin resistance in growing Thoroughbreds is affected by diet. K. Treiber^{*1}, R. Boston², D. Kronfeld¹, R. Hoffman¹, W. Staniar¹, and P. Harris³, ¹*Department of Animal and Poultry Sciences, Virginia Polytechnic Institute and State University, Blacksburg,* ²*Department of Clinical Studies, New Bolton Center, Kennett Square, PA,* ³*Equine Studies Group, WALTHAM Centre for Pet Nutrition, Melton-Mowbray, UK.*

Insulin resistance is associated with obesity and inactivity and may be a risk factor for metabolic disorder in horses. This study applied the minimal model to test the affect of diet on glucose and insulin in young horses. Twelve Thoroughbred foals were raised on pasture and supplemented twice daily with a feed high in either sugar and starch or fat and fiber. As weanlings (age 199 ± 19 d, weight 274 ± 18 kg) the subjects underwent a modified frequently sampled intravenous glucose tolerance test during which they remained in stalls and had access to grass hay and water ad libitum. Samples were collected at -60, -45, 1, 2, 3, 4, 5, 6, 7, 8, 10, 12, 14, 16, 19, 22, 23, 24, 25, 27, 30, 35, 40, 50, 60, 70, 80, 90, 100, 120, 150, 180, 210, 240, 270, 300, 330 and 360 min with a glucose bolus of 300 mg/kg BW at 0 min and an insulin bolus of 1.5 mU/kg BW at 20 min. Plasma was analyzed for glucose and insulin. Insulin sensitivity (SI), glucose effectiveness, acute insulin response to glucose (AIRg) and disposition index were derived using Minmod Millennium and WinSAAM software. Diets were compared using the non-parametric Kruskal-Wallis test and the sign test. Basal glucose did not differ between groups (P = 0.75). Insulin levels were higher in the sugar and starch adapted weanlings at all 36 sample points (P = 0.030). The fasting glucose:insulin ratio for the sugar and starch supplemented weanlings was lower than for fat and fiber weanlings (P = 0.025). Insulin sensitivity was lower in weanlings fed sugar and starch than weanlings fed fat and fiber (P = 0.007). Acute insulin response to glucose was inversely correlated with SI (r = -0.54; P = 0.068). The glucose:insulin ratio was directly correlated to SI (r = 0.63; P = 0.036). These results show that weanlings adapted to a supplement high in sugar and starch had lower insulin sensitivity compared to weanlings adapted to a fat and fiber feed. Weanlings adapted to sugar and starch appeared to compensate for a lower sensitivity to insulin by increasing insulin secretion. Feeding meals high in glucose equivalents may increase the risk of developing insulin resistance and associated disorders in horses.

Key Words: Horse, Insulin Resistance, Minimal Model

76 Somatotropic axis in growing Thoroughbreds is affected by diet. K. Treiber^{*1}, W. Staniar¹, D. Kronfeld¹, R. Boston², and P. Harris³, ¹*Department of Animal and Poultry Sciences, Virginia Polytechnic Institute and State University, Blacksburg,* ²*Department of Clinical Studies, New Bolton Center, Kennett Square, PA,* ³*Equine Studies Group, WALTHAM Centre for Pet Nutrition, Melton-Mowbray, UK.*

The somatotropic axis comprises a network of metabolites and hormones that link nutrition to growth. Feeds high in glucose equivalents cause exaggerated fluctuations in components of this network and may contribute to metabolic and growth disorders. This study analyzed samples from a frequently sampled intravenous glucose tolerance test (FSIGT) to determine the effect of diet on plasma concentrations of insulin, growth hormone (GH) and insulin-like growth factor-I (IGF-I) in growing horses. Twelve Thoroughbred foals were raised on pasture and supplemented twice daily with a feed high in either sugar and starch (SS) or fat and fiber (FF). As weanlings (age 199 ± 19 d, weight 274 ± 18 kg) the subjects underwent an FSIGT during which they remained in stalls and had access to grass hay and water ad libitum. Samples were collected at -60, -45, 1, 2, 3, 4, 5, 6, 7, 8, 10, 12, 14, 16, 19, 22, 23, 24, 25, 27, 30, 35, 40, 50, 60, 70, 80, 90, 100, 120, 150, 180, 210, 240, 270, 300, 330 and 360 min with a glucose bolus of 300 mg/kg BW at 0 min and an insulin bolus of 1.5 mU/kg BW at 20 min. The minimal model was used to estimate insulin sensitivity (Si). Plasma was analyzed for

glucose, insulin, GH and IGF-I concentrations. Feed groups were compared using the non-parametric Kruskal-Wallis test. Time interactions for IGF-I were compared by ANOVA with repeated measures. Robust linear regression was used for correlations. Growth hormone concentrations were increased from basal 19 to 180 min after the glucose dose (P < 0.05). Basal IGF-I was higher (P = 0.006) in the SS group compared to the FF group. Concentrations of IGF-I increased with time (P = 0.002) in the SS group. Basal IGF-I was inversely correlated to SI (-r = 0.52; P = 0.10). These results show that weanlings adapted to meals high in glucose equivalents have higher IGF-I secretion as compared to weanlings adapted to a fat and fiber supplement. This deviation may be associated with insulin resistance and metabolic dysfunction in horses fed concentrates high in hydrolyzable carbohydrates.

Key Words: Diet, Growth Hormone, Insulin-Like Growth Factor-I

77 Environmental factors and nutrient composition of pasture in northern Virginia. T. A. Cubitt^{*}, W. B. Staniar, and D. S. Kronfeld, *Department of Animal and Poultry Science, Virginia Polytechnic Institute and State University, Blacksburg.*

Greater than 90% of horses in Virginia receive all or part of their nutrition from pasture (USDA/APHIS, 1988). The objective of this study was to test for association between environmental factors and pasture variables, and to compare equine requirements for growth and reproduction, as recommended by the NRC (1989), to nutrient content determined by proximate analysis of pasture samples taken at monthly intervals for 5 y in northern Virginia. Day length (DL, h) and temperature (T, C) were measured. Statistical analysis included Pearson correlations, linear regressions and quadratic curves (SAS, 2000). Significant associations were found between DL and CP (r = -0.16, P = 0.02), ADF (r = 0.24, P = 0.0004), and NSC (r = -0.15, P = 0.04). Temperature significantly correlated with DM (r = 0.76, P = 0.0001), CP (r = -0.23, P = 0.0007), ADF (r = 0.32, P < 0.0001), and NSC (r = -0.19, P = 0.004). A quadratic relationship was fit between CP and T with an R² = 0.20, P < 0.0001. A linear regression fit to ADG (kg/d) versus CP resulted in an R² = 0.11, P < 0.0001. The data was adjusted for the delay in change in ADG as compared to CP, to give a clearer indication of the strength of the association and the resulting R² = 0.23, P < 0.0001. In comparison to the requirements for growth and reproduction the pastures tested were deficient in Zn, Cu and P. Crude protein was above the requirements set by the NRC (1989). This study presents a temporal relationship between environmental factors, nutrients in the pasture, and growth variables. We suggest that certain minerals are below the recommended minimums listed in the NRC for horses at certain times of year. This data is useful in developing sound management practices for horses raised on pasture.

Key Words: Nutrient Requirements, Horses, Pasture

78 The effects of age, breed, gender and use on gastric ulceration in the horse. K. Chameroy^{*}, J. Nadeau, S. Bushmich, J. Dinger, and T. Hoagland, *University of Connecticut, Storrs.*

Gastric ulceration in horses has been identified as a serious health concern. The goal of this study was to determine if there was an effect on the occurrence of ulcers among a genetically diverse population of horses composed of several different ages, breeds, gender, and use. Eighty horses ranging in age from 2 years to 23 years were used. Their breeds consisted of Morgans, Quarter horses, Warmbloods, Thoroughbreds, and grade horses. Mares and geldings were included. All horses were used in one of three different capacities: polo, lessons, or training. Horses were examined by endoscopic examination, visible ulcers were scored according to an accepted gastric ulcer scoring system. Comparisons of the distribution of the occurrence of ulcers, lesion number, and lesion severity scores were made with chi square analyses using an expected occurrence of 30% based on two previous studies. Nine of the 80 horses