
GRADUATE STUDENT COMPETITION:
ADSA PRODUCTION ORAL
COMPETITION, MS

0334 Nutrient utilization and metabolism by lactating dairy cows fed high-forage diets with protein supplements. K. Neal^{*1}, J. S. Eun¹, A. J. Young¹, and K. Mjoun², ¹Utah State University, Logan, ²Alltech, Brookings, SD.

Due to the increasing cost of soybean meal and concerns of excess N being excreted into the environment, new protein supplements have been developed. Two products that have shown potential in increasing N utilization efficiency are slow release urea (SRU; Optigen, Alltech, Nicholasville, KY) and ruminal escape protein derived from yeast (YMP; DEMP, Alltech). The objective of this study was to assess the effects of feeding these 2 supplements in high-forage (54% of total dietary DM) dairy diets on nutrient utilization, feed efficiency, lactational performance of dairy cows, and their impacts on income-over feed costs (IOFC). Twelve multiparous dairy cows were used in a triple 4 × 4 Latin square design with one square consisting of ruminally cannulated cows. Treatments included: 1) control, 2) SRU-supplemented TMR (SRUT), 3) YMP-supplemented TMR (YMPT), and 4) SRU and YMP-supplemented TMR (SYT). The control consisted only of a mixture of soybean meal and canola meal (SBMCM) in a 50:50 ratio. The SRU and the YMP were supplemented at 0.49% and 1.15% DM, respectively. The experiment consisted of 4 periods lasting 28 d each (21 d of adaptation and 7 d of sampling). Cows fed YMPT and SYT had decreased DMI, and all supplemented treatments had lower CP intake compared to those fed the control. Milk yield tended ($P = 0.08$) to have the greatest increase in YMPT compared with the control (41.1 vs. 39.7 kg/d) as well as a tendency for increased milk fat ($P = 0.10$) and protein yields ($P = 0.07$). Feed efficiencies were improved in all diets with protein supplementation at 10–16% ($P < 0.04$). Cows fed with protein supplements partitioned less energy toward BW gain, but tended ($P = 0.08$) to partition more energy toward milk production. Efficiency of use of feed N to milk N increased by feeding SRUT and YMPT, and milk N to manure N ratio increased in YMPT. Cows fed SRUT or YMPT tended ($P < 0.10$) to improve IOFC. Overall results from this experiment indicate that replacing SBMCM with SRU and YMP in high-forage dairy diets can be a good approach to enhance farm profitability through improved nutrient utilization efficiencies by lactating dairy cows.

Key Words: dairy profitability, high-forage dairy diet, protein supplement

0335 Individual and additive value of conventional and non-conventional technologies in beef steers housed in small research pens. A. R. Harding¹, G. K. Jim², C. W. Booker², E. J. Behlke², S. L. Parr², S. J. Hannon², T. M. Greer², Z. D. Paddock², M. L. May², L. O. Burciaga-Robles², and C. R. Krehbiel¹. ¹Oklahoma State University, Stillwater; Feedlot Health Management Services, Ltd., Okotoks, AB, Canada.

This trial was conducted at a research feedlot in Alberta, Canada to evaluate the effects of conventional and non-conventional production technologies identified from previous research in feedlot steers. The study utilized 960 steers stratified by BW and randomly allocated to one of four treatments: rumensin/tylan/growth-promotant free (RT), Oleo/growth-promotant free (O), negative control (NC), or conventional (CON). The RT cattle received Rumensin and Tylan (Elanco Animal Health), and did not receive an implant or β -agonist. The O cattle were fed 1 g/animal/day of Oleobiotec Ruminant (Oleo; Laboratoires Phodé, Terssac, France), and did not receive an implant or β -agonist. The NC cattle received a non-medicated supplement of vitamins and minerals and did not receive an implant or β -agonist. Cattle in the CON group received a hormonal implant (Revalor-200; Merck Animal Health, Intervet Canada Corp., Kirkland, Québec), Rumensin, Tylan and Optaflexx (Elanco Animal Health) at the end of the feeding period. All study animals received a barley-based finishing diet and were housed by treatment in 48 research pens. Data were analyzed using the GLIMMIX procedure (SAS Institute Inc, Cary, North Carolina). Final BW and HCW were lower for the RT, O, and NC ($P < 0.001$) cattle relative to the CON cattle. In addition, RT, O, and NC cattle had decreased ADG and poorer G:F on both a live and carcass adjusted basis ($P < 0.001$) relative to the CON cattle. The RT cattle had improved G:F compared to the O and NC cattle on a live weight basis ($P < 0.001$). The RT cattle also had better G:F compared to the NC cattle on a carcass adjusted basis ($P < 0.001$). Cattle in the O group tended ($P = 0.051$) to have improved G:F compared to NC cattle on a carcass weight basis. No differences in carcass quality or animal health were detected between experimental groups. These results indicate that animal performance can be improved with conventional (implant, β -agonist, ionophore, and antimicrobial) or non-conventional (Oleobiotec) production technologies relative to a negative control.

Key Words: feedlot, cattle, technology

0336 The effects of supplementing two pasteurized milk balancer products to pasteurized whole milk on the health and growth of dairy calves.

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Neonatal Holstein heifer calves ($n = 72$) received one of three dietary treatments: M (no supplement), MB (Land O'Lakes Pasteurized All-Milk Balancer), or MPB (Land O'Lakes Pasteurized Protein-Blend Balancer) from d 1 through weaning at d 56. Two locations were used in this trial, NCSU Lake Wheeler Dairy (Raleigh, NC) and NCDA Piedmont Research Station (Salisbury, NC), with 36 calves on trial at each site. All calves were removed from their dams after birth (d 0) and fed 3.8 L pasteurized colostrum. All calves were fed pasteurized whole milk from d 1 through d 56. Calves were fed 3.8L milk divided into 2 equal feedings from d 1 through d 14 and 5.7L milk divided into 2 equal feedings from d 15 through weaning at d 56. Supplements given to MB and MPB were included at a rate of 0.23kg of their respective balancer per 3.8L of pasteurized whole milk. Calves were weighed and measured for wither height (WH), hip height (HH), and hip width (HW) every 7 d from birth until weaning at d 56. Average daily gain (ADG) and feed efficiency (FE) were calculated from d 0 through d 56. Feed efficiency is the ratio of total gain to total dry matter intake (DMI), which included milk balancer DM and calf starter DM consumed. A contrast statement was used to compare M to the average of MB and MPB, and a second contrast compared the two supplemented treatments, MB versus MPB. Calves fed MB and MPB had greater body weight (BW), ADG, HW and WH when compared to calves fed M. Calves fed MB or MPB performed similarly.

Key Words: calf, milk balancer, pasteurized

Table 0336. BW, HH, HW, WH, ADG and FE as affected by treatment for 72 Holstein heifer calves from birth through weaning at 56 d

	Treatment			SEM	M vs. 1/2 (MB+MPB)	MB vs. MPB
	M	MB	MPB		$P \leq$	$P \leq$
BW, kg	53.8	56.7	58.19	1.0	0.01	0.3
HH, cm	85.0	85.5	86.3	0.7	0.2	0.3
HW, cm	18.8	19.0	19.4	0.2	0.04	0.1
WH, cm	80.4	81.1	82.1	0.7	0.04	0.1
ADG, kg	0.70	0.80	0.77	0.03	0.01	0.3
FE, total gain/ total DMI	0.75	0.69	0.64	0.04	0.09	0.4

0337 Relationship between fertility and postpartum changes in body condition and body weight in lactating dairy cows. P. D. Carvalho¹,

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The relationship between energy status and fertility in dairy cattle was analyzed retrospectively by: analyzing the effect of early postpartum changes in body condition score (BCS; Expt 1) and post-partum changes in body weight (Expt 2) on fertility. To reduce the effect of cyclicity status, all cows were presynchronized with Ovsynch before to a second Ovsynch and timed AI (TAI after Double-Ovsynch; Expt 1; First GnRH at 53 ± 3 DIM; TAI at 80 ± 3 DIM) or synchronized superovulation (Expt 2). Data were analyzed by logistic regression with GLIMMIX and ANOVA using the MIXED procedure of SAS. In Expt 1, lactating dairy cows on two commercial dairies ($n = 1887$) were divided by BCS change from calving until third week postpartum. Overall, P/AI at 70 d pregnancy diagnosis differed dramatically ($P < 0.001$) by BCS change and were least for cows that lost BCS, intermediate for cows that maintained BCS, and greatest for cows that gained BCS (22.8% [180/789], 36.0% [243/675], and 78.3% [331/423], respectively). Effects of BCS change on fertility were similar for primiparous and multiparous cows, but differed by farm with BCS change dramatically affecting ($P < 0.001$) P/AI on one farm however there was no effect ($P = 0.35$) on the other farm. In Experiment 2, body weight of lactating dairy cows ($n = 71$) was measured weekly from first to ninth week postpartum. Cows were divided into quartiles by percentage of body weight change from calving until third week postpartum. (Q1 = +2.39%; Q2 = -0.07%; Q3 = -3.50%; Q4 = -6.84%). Cows were superovulated (TAI = 70 ± 3 DIM) and there was no effect of quartile on number of ovulations (17.9), total embryos/oocytes collected per cow (8.5), or percentage of oocytes that were fertilized (77.5%). In contrast, the percentage of fertilized oocytes that were transferable embryos was greater ($P = 0.04$) for cows in Q1, Q2 and Q3 than Q4 (83.8%, 75.2%, 82.6%, and 53.2%, respectively). In addition, percentage of degenerated embryos was less ($P = 0.02$) for cows in Q1, Q2, and Q3 compared to Q4 (9.6%, 14.5%, 12.6%, and 35.2% respectively). In conclusion, change in BCS during the first 3 wk postpartum had a profound effect on P/AI to first TAI. This effect could be partially explained by the reduction in embryo quality and increase in degenerate embryos 7 d after AI in cows that lost more body weight from first to third week postpartum. Supported by Hatch project WIS01171.

Key Words: BCS loss; body weight loss; embryo quality; fertility

0338 Effect of serum calcium status at calving on survival, health, and performance of postpartum dairy cows and calves. A. Hunter*¹,

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Limited evidence is available in the literature about the effect of hypocalcemia (HYPO) of dams at calving on survival and health of calves. The objective was to assess the effect of clinical and subclinical HYPO (≤ 8 mg/dL) at calving on survival, health, and performance of lactating dairy cows and calves. Prepartum dairy cows (primiparous, $n = 450$; multiparous, $n = 334$) from one dairy herd were monitored (close-up pen) for imminent signs of birth (appearance of amniotic sac outside the vulva) until birth. Calving ease, time of birth, single or multiple calves, calf sex, and stillbirth (born dead or died within 24 h after birth), BCS immediately after calving, and hygiene score of the perineum were recorded. All female calves were subject to the same newborn care and colostrum management. Total serum Ca (HYPO) of cows was determined within 2 h after calving. The effect of HYPO on survival (died or culled within 30 DIM), metritis, and pregnancy per AI (P/AI) for first services of lactating cows were assessed using GLIMMIX. The effect of HYPO on calf survival, failure of passive transfer (FPT; serum total proteins ≤ 5.5 mg/dL), and diarrhea within 10 d of age were assessed using GLIMMIX. Diarrhea was defined as a calf presenting fluid or bloody feces (scores 2-3; 0-3 scale) and $> 5\%$ dehydration or fever ($\geq 39.5^\circ\text{C}$). The overall prevalence of HYPO was 15%. Cows experiencing HYPO at calving had greater proportion ($P < 0.05$) of metritis (29.4%) and culling within 30 DIM (23.5%) compared to non-hypocalcemic cows (17.3% and 6.9%, respectively). The proportion of P/AI at first service was not different between HYPO (30%) and non-HYPO cows (37%; $P > 0.05$). The proportion of stillbirth and FPT was not different ($P > 0.05$) between calves born from HYPO or non-HYPO cows. However, calves born from HYPO cows had greater (49%; $P < 0.05$) proportion of diarrhea than those calves born (33.3%) from non-HYPO cows. Dairywomen, consultants, and veterinarians often trouble-shoot transition cow diseases and this process requires constant monitoring and comprehensive assessment of several events. Findings from the present study showed that HYPO at calving had significant health implications for both dams and calves.

Key Words: hypocalcemia, cow and calf health, dairy

0339 Sodium salicylate decreases glucose turnover rate in periparturient dairy cows, likely through enhanced liver insulin sensitivity.

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Low-grade inflammation has been implicated as a contributor to metabolic disease during the transition to lactation. However, in previous work, administration of sodium salicylate (SS) for 7 d led to hypoglycemia in mature dairy cows in early lactation. The purpose of this study was to identify the mode of action underlying this response to SS. Twenty mature (3+ parity) cows were assigned alternately at time of calving to either control (CON) or SS treatments. CON treatment received a molasses carrier in drinking water while the SS received 2.5 g/L SS with the molasses carrier in drinking water for 7 d after parturition. Blood samples were collected daily. A glucose turnover assay was performed on Day 7, followed by liver, muscle, and adipose tissue biopsies. Results were analyzed in the MIXED procedure of SAS with significance declared at $P < 0.05$. There were no treatment effects on DMI ($P = 0.98$) or water intake ($P = 0.61$). Tumor necrosis factor α (TNF α) mRNA expression was decreased by SS in adipose tissue ($P = 0.09$), but not in muscle ($P = 0.97$) or liver ($P = 0.52$), and plasma haptoglobin was not altered by treatment ($P = 0.34$). Though treatment did not alter plasma glucose or insulin concentrations, RQUICKI, a measure of insulin sensitivity, and plasma glucagon tended to be increased by SS ($P = 0.08$ for both). The insulin:glucagon ratio was increased by SS ($P = 0.01$). Cows on SS had a 25% decrease in glucose turnover rate ($P = 0.05$). There were no differences in mRNA expression of gluconeogenic genes in liver or of GLUT4 transporters in any of the tissues. These results indicate that SS may increase insulin sensitivity in mature fresh cows. This increase in sensitivity of insulin could explain the lower glucose turnover rate because of increased post-transcriptional inhibition of gluconeogenesis by insulin during SS treatment.

Key Words: NSAID, transition cow, insulin resistance

0340 Effects of elevated subcutaneous fat stores on serum nonesterified and milk fatty acid profile and peripheral blood mononuclear cells gene expression of pro-inflammatory markers and production measures in periparturient dairy cows. C. M. Scholte*, K. C. Ramsey, C. Y. Tsai,

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Dairy cows with greater subcutaneous fat stores release greater concentrations of nonesterified fatty acids (NEFA) into the blood during the periparturient period. The objective of this study was to determine the effect of elevated lipid mobilization during the periparturient period on serum NEFA and milk fatty acid (FA) profile, peripheral blood mononuclear cells

(PBMC), gene expression of selected markers of inflammation and production measures. Thirty-four cows were blocked by parity; treatment received a dry cow ration with an additional 10 kg of corn/head per day starting -28 d relative to parturition. The control received the dry cow ration (no additional corn) with 400 mg of monensin/head per day. Immediately postpartum, cows were fasted for 8 h. Serum samples were collected on -28, -7, +1, +6, +15, and +21 d for FA analysis of specific lipid fractions. Milk samples were obtained on +1, +3, +6, +15, and +21 d for composition, yield, and FA analyses. Real-time q-PCR gene analysis for intercellular adhesion molecule 1 (*ICAM-1*), interleukin (*IL*) 1 β and 6, and tumor necrosis factor- α (*TNF- α*) was performed on PBMC collected on -28, +3, +12, and +21 d. Data were analyzed as repeated measures analysis of variance using mixed model procedures in SAS (9.3) and significance was declared at $P \leq 0.05$. Within serum NEFA fraction, C16:1, sum of C18:1 *trans*, and C18:3n3 were greater in control than in treatment prepartum, but no significance was detected in postpartum. In contrast, sum of C18:1 *trans* was greater in treatment compared with that of control during postpartum period. Serum concentration of C20:4n6 tended to be greater in treatment compared with that of control (1.12 vs. $0.86 \pm 0.11\%$; $P = 0.06$). In milk fat, C16:1 and C18:2 *cis* were greater for treatment and C15:0, C18:3n3 and C22:2 were lower for treatment compared to with control. Gene expression for *IL-1 β* in PBMC was greater for control, whereas *ICAM-1*, *IL-1 β* , *IL-6*, and *TNF- α* were greater in primiparous than multiparous cows, without a detectable treatment effect. Prepartum, control cows consumed more feed than treatment. Postpartum intake indicated a marginal treatment \times time interaction, with intake wavering until d +11 and treatment consuming relatively more thereafter. In summary, increased subcutaneous fat stores altered FA profile of serum NEFA fraction and milk as well as gene expression of PBMC in periparturient dairy cows.

Key Words: lipid mobilization, fatty acid profile, peripheral blood mononuclear cells

0341 Effect of prophylactic and therapeutic antibiotic administration on fecal excretion of antibiotic resistance genes by dairy cows. L. R. Caudle*, H. M. Littler, A. Pruden, X. Feng, and K. F. Knowlton, *Virginia Tech, Blacksburg.*

The objective of this study was to determine the effect of prophylactic and therapeutic antibiotic administration on fecal excretion of antibiotic resistance genes (ARG) in dairy cows. Twelve primiparous lactating Holstein cows were used in a completely randomized design. Four treatments included the administration of cephalosporin (intramammary), pirlimycin (intramammary), or ceftiofur (subcutaneous), as well as a control group where no antibiotic was given. Fecal samples were collected from all cows before antibiotic administration on d 0 and then on d 1, 3, 5, 7, 14, 21, and 28 following treatment.

Fecal samples were freeze-dried and DNA was extracted using the FastDNA Spin Kit for Soil. Extracted DNA was analyzed using quantitative polymerase chain reaction for genes encoding for resistance to tetracyclines (*tetO* and *tetW*) and β -lactams (*ampC*) as well as a housekeeping gene (16S rRNA) to monitor bacterial abundance. Statistical analysis was performed using Proc Glimmix in SAS with a model including treatment, day, and their interaction with pre-treatment (d 0) abundance as a covariate. Absolute (log₁₀ copies/g feces) and relative (gene copies/16S rRNA) abundance of *tetO*, *tetW*, and *ampC* were not influenced by antibiotic treatment. Absolute abundance of 16S rRNA was lower ($P < 0.04$) in feces of pirlimycin-treated cows than in feces of cephalosporin-treated cows and also tended to be lower ($P < 0.06$) than in feces of control cows. This suggests effects of pirlimycin on total fecal bacterial numbers. There was an effect of day on relative abundance of *tetW* ($P < 0.04$) and *ampC* ($P < 0.04$) in all cows, with fecal excretion highest on d 3 post-treatment. Absolute abundance of *tetW* in feces was influenced by day ($P = 0.01$), with excretion highest 28 d post-treatment. In this study, prophylactic and therapeutic antibiotic administration did not increase excretion of the three target ARG by dairy cows. The observed temporal pattern in ARG excretion will help identify the most useful time frame for possible interventions to reduce dissemination of ARG from dairy farms. These results will inform further analysis of the entire complement of known ARG using shotgun metagenomics.

Key Words: antibiotic resistance genes, dairy cow, feces

0342 Effects of oscillating the crude protein content in dairy cow rations. A. N. Brown*¹ and W. P. Weiss², ¹*The Ohio State University, Wooster*, ²*Department of Animal Sciences, The Ohio State University, Wooster.*

Overfeeding crude protein (CP) is a common practice in the dairy industry to reduce the risk of a loss in milk; however, overfeeding CP increases costs and negatively impacts the environment. We hypothesized that oscillating dietary CP concentrations to equal the average concentration of a diet limited in metabolizable protein (MP) for lactating dairy cows will improve milk protein yield and milk N efficiency because oscillating CP should stimulate nitrogen recycling to the rumen. Twenty-one Holstein dairy cows averaging 123 DIM were randomly assigned to a treatment sequence in seven 3 \times 3 Latin Squares with 28-d periods. The control diet contained 16.4% CP (MP allowable milk = 47 kg/d), the low protein diet contained 13.4% CP (MP allowable milk = 31 kg/d), and the oscillating treatment consisted of a diet with 10.3% CP fed for 2 d followed by a diet with 16.4% CP fed for 2 d repeated over the 28 d period to average 13.4% CP. The cows were fed once daily and milked twice daily. Cows on the low protein diet had greater DMI than cows on the oscillating treatment (24.8 kg/d vs. 24.3 kg/d; $P = 0.04$) but were similar in DMI compared to

cows on the control diet (24.8 kg/d). There was no treatment difference ($P > 0.05$) for milk yield (avg. 34.6 kg/d), feed efficiency, milk fat yield, milk fat content, and milk protein content. Milk protein yield showed a treatment effect; however, treatment contrasts showed no difference between the oscillating treatment and low treatment and between the high and low treatments. Milk urea nitrogen (MUN) increased with protein content of the diet (14.5 mg/dl vs. 9.1 mg/dl; $P < 0.0001$) with no difference in MUN between cows fed the low and oscillating treatments except that MUN followed a cyclic pattern for oscillating cows. Given that cows on the low diet produced more milk than MP allowable milk, cows on the low protein diet used nitrogen more efficiently than expected or the NRC overestimated the requirements. Although milk and milk protein production were not affected by the oscillating treatment, very little research has been done on oscillating CP content of dairy cows rations; therefore, this study is a first step in understanding how oscillating protein affects dairy cows.

Key Words: dairy cow, metabolizable protein, oscillating protein

0343 Interaction among energy status and retinoid status in periparturient dairy cows: production, milk retinoid, and metabolic response.

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An objective of this study was to determine the effect of feeding various amounts of dietary vitamin A (0 or 110 IU/kg BW), crude protein (12.5% or 16%), and an ionophore (monensin at 0 or 400 mg/d per head) on performance measures, retinoid metabolism, immune system, and metabolic response. Multiparous Holstein dairy cows ($n = 80$) were studied from day -35 to +21 relative to expected parturition, in a complete randomized block design with a $2 \times 2 \times 2$ factorial arrangement of treatments. Milk samples were obtained at the first, second, third milking, and every 3 d thereafter, and processed for components, somatic cell count (SCC), retinol, α -tocopherol, and β -carotene. Serum samples were collected on d -35, -7, +3, +9, +21 and processed for NEFA, BHBA, haptoglobin, and thiobarbituric acid reactive species (TBARS). Peripheral blood mononuclear cells (PBMC) were also isolated on d +7. Real time qPCR gene analysis for intercellular adhesion molecule (*ICAM-1*), interleukin (*IL*) 1 β and 6, and tumor necrosis factor- α (*TNF- α*) were performed on PBMC. Significance of treatments was declared at $P \leq 0.05$. Results indicated vitamin A reduced ($P = 0.05$) milk SCC with no effect on milk yield or composition, DM intake both pre- and postpartum. An effect of CP \times monensin on milk retinol concentration was observed (2.19, 1.72, 2.12, and 2.35 ± 0.16 μ g/mL for low CP + monensin, low CP- monensin, high CP + monensin, and high CP- monensin, respectively; $P = 0.03$), but no differences in milk α -tocopherol and β -carotene were found.

Furthermore, serum haptoglobin was lower ($P = 0.03$) with greater dietary CP. Also, cows that received monensin had lower ($P = 0.013$) serum haptoglobin postpartum compared with the prepartum concentrations observed. No differences in serum NEFA, BHBA, or TBARS were detected. Cows that received greater CP had increased gene expression of *TNF- α* ($P = 0.04$) in PBMC, but not effect on gene expression of *ICAM-1*, *IL-1 β* , and *IL-6* was found. Overall, these observations show that dietary vitamin A, monensin and protein affect retinol and SCC in milk without affecting performance measures. Further studies are needed to fully understand the retinoid metabolism in the transition dairy cow.

Key Words: transition cows, retinoids, gene expression

0344 Reproductive performance of timed artificial insemination and activity-based estrus detection.

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A study comparing reproductive management programs without visual estrus detection was conducted using 268 cows from 2 commercial dairy herds in Kentucky between October 2012 and November 2013. Before enrollment, resumption of ovarian activity was confirmed and BCS was evaluated. Eligible cows (BCS ≥ 2.5) were balanced for parity and predicted milk yield then randomly assigned to 1 of 2 treatments: TAI or activity. Ovulation synchronization using G7G/Ovsynch and Resynch occurred up to 3 times for all cows assigned to the TAI treatment. Cows assigned to the activity treatment received a leg-mounted accelerometer (AfiTag Pedometer Plus, S.A.E. afimilk, Kibbutz Afikim, Israel) and were bred according to estrus alerts created by the system algorithm for up to 90 d after the voluntary waiting period (VWP). Pregnancy diagnosis via ultrasound occurred 33 to 46 d after insemination and pregnancy loss was determined between 60 and 74 d bred. The GLM procedure of SAS (SAS Institute, Inc., Cary, NC) was used to evaluate the effects of treatment (TAI or activity), herd (1 or 2), temperature humidity index (THI), parity (primiparous or multiparous), BCS (≤ 2.75 or ≥ 3.00), summit milk, and their interactions on days to first service, first service conception rate (CR1), repeat service conception rate (≥ 2 CR), days open (DO), pregnancy loss (PL), and percent pregnant at the end of the 90 d study period (%P90). Stepwise backward elimination removed all nonsignificant interactions ($P \geq 0.05$). Main effects remained in each model regardless of significance. Days to first service was lower ($P < 0.01$) for the TAI group than for the activity group (6.21 ± 0.98 vs. 18.30 ± 0.99 d after the VWP, respectively). Treatment was not a predictor of CR1 (TAI: $46.89 \pm 4.43\%$ vs. activity: $43.78 \pm 4.47\%$, $P = 0.61$), ≥ 2 CR (TAI: $41.15 \pm 4.88\%$ vs. activity: $39.92 \pm 4.95\%$, $P = 0.86$), DO (TAI: 33.16 ± 3.09 vs. activity: 33.08 ± 3.02 d after the VWP, $P = 0.98$), PL (TAI: $16.97 \pm 3.33\%$ vs. activity: $10.77 \pm 3.43\%$, $P = 0.14$), and %P90 (TAI: $65.54 \pm 4.57\%$ vs. activity: $66.11 \pm 4.43\%$, $P = 0.92$). These

results indicate that continuous activity monitoring can produce similar reproductive performance to TAI.

Key Words: activity monitoring, timed artificial insemination, estrus detection

0345 Energy content of reduced-fat distillers grains for lactating dairy cows. A. Foth^{*1}, G. Garcia Gomez¹, T. Brown-Brandl², H. C. Freetly³, and P. J. Kononoff¹, ¹University of Nebraska, Lincoln, ²ARS-USDA, Clay Center, NE, ³USDA, ARS, US MARC, Clay Center, NE.

The corn-ethanol industry has started to produce distillers grains and solubles that contain a reduced concentration of fat (RFDDGS), but the impact of this feed on the supply of energy to the cow has not been studied in depth. Eight Holstein and 8 Jersey multiparous, lactating cows were used to complete 56 energy balances to determine the energy content of rations containing RFDDGS. A repeated switchback design was used to compare treatments with and without RFDDGS. On a DM basis, treatments consisted of 24.2% corn silage, 18.4% alfalfa hay, 6.94% brome hay with either 22.9% rolled corn and 14.8% soybean meal, or 4.51% rolled corn, 14.5% RFDDGS, and 0% soybean meal (DM basis). The inclusion of RFDDGS increased DMI from 21.7 ± 0.70 kg/d to 23.3 ± 0.68 kg/d ($P < 0.01$) but did not affect milk production (30.4 ± 1.46 kg/d; $P = 0.11$). However, 3.5% FCM tended ($P = 0.10$) to be different (33.0 ± 1.27 and 34.2 ± 1.25 kg/d for Control and RFDDGS treatment, respectively). Milk energies were 1.44 ± 0.50 Mcal/d higher with RFDDGS ($P = 0.01$). Energy lost as methane was reduced ($P = 0.01$) by 0.28 Mcal/d with the addition of RFDDGS. Heat loss averaged 30.4 ± 0.55 Mcal/d and did not differ by treatment ($P = 0.94$). Energy retained as tissue energy was found to be -0.22 ± 1.48 Mcal/d for the Control and 6.78 ± 1.43 Mcal/d for the RFDDGS treatment ($P < 0.01$). Intakes of digestible and metabolizable energies were lower ($P < 0.01$) for the Control (2.70 and 2.36 ± 0.05 Mcal/kg DM, respectively) compared to RFDDGS (2.86 and 2.54 ± 0.05 Mcal/kg DM). There was also a treatment by breed interaction ($P < 0.01$) with a greater difference between treatments with Holstein cows than Jersey cows. Differences between treatments in Holsteins were 12.0 ± 2.09, 11.7 ± 1.98 and 11.3 ± 1.90 Mcal/d ($P < 0.01$), and Jerseys were 4.16 ± 2.14, 4.32 ± 2.04 and 5.47 ± 1.96 Mcal/d ($P = 0.06, 0.04$ and 0.01), for digestible, metabolizable and lactational net energies, respectively. These energy estimates suggest higher energy content of diets containing RFDDGS than diets containing a mixture of corn and soybean meal in lactating dairy cows.

Key Words: reduced-fat distillers grains with solubles, energy balance, methane

0346 Relationship between digestibility and residual feed intake in lactating Holstein cows fed high and low starch diets. S. E. Burczynski^{*}, J. P. Boerman, A. L. Lock, M. S. Allen, and M. J. VandeHaar, Michigan State University, East Lansing.

We determined if differences in digestibility among cows explained variation in residual feed intake (RFI) in 3 crossover design experiments. Lactating Holstein cows ($n = 89$; 107 ± 27 DIM) were fed diets high (HI) or low (LO) in starch. LO diets were ~38% NDF and ~14% starch; HI diets were ~26% NDF and ~32% starch. Each experiment consisted of two 28-d treatment periods, with digestibility measured during the last 5 d. Individual DMI and milk yield were recorded daily, BW was measured 3–5 times per wk, and milk components were analyzed twice weekly. DMI was modeled as a function of milk energy output, metabolic BW, body energy gain, and fixed effects of parity and cohort, with the residual being RFI. High RFI cows are less efficient because they eat more than expected for a given multiple of maintenance based on requirements. RFI was negatively correlated with digestibility of starch for both HI ($r = -0.25$; $P = 0.02$) and LO diets ($r = -0.20$; $P = 0.07$), and with digestibility of DM ($r = -0.30$; $P < 0.01$) and NDF ($r = -0.24$; $P = 0.03$) for LO diets but not HI diets ($P > 0.4$). Cows with the highest RFI (HiRFI) and the lowest RFI (LoRFI) were those greater or less than 1 SD of the mean for each cohort. For HI diets, LoRFI cows tended to have greater starch digestibility than HiRFI (96 vs. 94%; $P = 0.08$), but similar digestibilities ($P > 0.2$) of DM (67%) and NDF (37%). For LO diets, LoRFI cows tended to have greater DM digestibility (66 vs. 64%; $P = 0.08$), but similar starch (95%; $P > 0.2$) and NDF (50%; $P > 0.3$) digestibilities. Apparent NE_L concentrations for HI and LO diets, based on cow performance, were 21 and 12% greater ($P < 0.01$), respectively, for LoRFI cows than HiRFI cows. LoRFI cows had 3% greater DM digestibility than HiRFI cows for LO diets, which accounted for 25% of their greater ability to extract NE_L from the same diet. Although digestibility differed for LoRFI and HiRFI cows, some of the differences were expected because high RFI cows eat at a higher multiple of maintenance, which should depress digestibility. Based on these data, we conclude that a cow's digestive ability explains none of the variation in RFI for cows eating high starch diets but may explain as much as 25% of the variation in RFI among cows eating low starch diets.

Key Words: residual feed intake, digestibility, dietary starch

0347 Evaluation of the effects of vitamin D and toll-like receptor signaling pathways on expression of antibacterial β -defensin genes in bovine neutrophils and mammary epithelial cells.

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Bacterial infection in the udder stimulates synthesis of 1,25-dihydroxyvitamin D₃ (1,25(OH)₂D₃) from 25-dihydroxyvitamin D₃ in macrophages that are in the mammary glands. The 1,25(OH)₂D₃, along with toll-like receptor (TLR) recognition of pathogen associated molecules, enhances the expression of β -defensin 3 (*DEFB3*), *DEFB6*, *DEFB7*, and *DEFB10* genes in bovine macrophages. The β -defensin genes encode for small cationic peptides that have potent bactericidal and immunomodulatory activity. Neutrophils and mammary epithelial cells (MEC) are additional sources of β -defensin peptides in the udder. It was hypothesized that 1,25(OH)₂D₃ and TLR agonists also would promote expression of the β -defensins in neutrophils and MEC. Therefore, the objective of this study was to determine the contribution of vitamin D and TLR signaling pathways on expression of *DEFB3*, *DEFB4*, *DEFB6*, *DEFB7*, and *DEFB10* genes in bovine neutrophils and MEC. Peripheral blood neutrophils from cattle and primary bovine MEC cultures were treated with 0 or 1 μ g/mL lipopolysaccharide (LPS) in combination with 0 or 10 nM 1,25(OH)₂D₃. The mRNA transcripts of *DEFB3*, *DEFB4*, *DEFB6*, *DEFB7*, and

DEFB10 genes were quantified by real-time PCR. The threshold cycle (Ct) for each gene was normalized to ribosomal protein S9 transcript abundance and the normalized Ct values for each treatment were analyzed with a general linear model to test for effects of 1,25(OH)₂D₃ and LPS treatments. In contrast to macrophages, 1,25(OH)₂D₃ did not upregulate expression of the *DEFB3*, *DEFB6*, *DEFB7*, or *DEFB10* genes in either non-stimulated or LPS-stimulated neutrophils or MEC ($P > 0.05$). However, the 1,25(OH)₂D₃ treatment increased *DEFB4* gene expression 5 \pm 1-fold ($P < 0.05$) in MEC not treated with LPS, and 3 \pm 1-fold ($P < 0.05$) in MEC treated with LPS. Furthermore, LPS combined with 1,25(OH)₂D₃ upregulated *DEFB4* 30-fold ($P < 0.05$) compared to MEC cultured in the absence of LPS and 1,25(OH)₂D₃. The LPS treatment alone upregulated *DEFB3*, *DEFB4*, and *DEFB7* in MEC ($P < 0.05$; 3 \pm 1, 11 \pm 3, and 8 \pm threefold change \pm SE, respectively), and *DEFB3*, *DEFB4*, *DEFB6*, *DEFB7*, and *DEFB10* in neutrophils ($P < 0.05$; 121 \pm 44, 10 \pm 7, 144 \pm 85, 112 \pm 51, and 56 \pm 22, fold change \pm SE, respectively). In conclusion, 1,25(OH)₂D₃ does not enhance β -defensin gene expression in bovine MEC or neutrophils as it does in macrophages. However, LPS does strongly enhance several of the β -defensins in MEC and neutrophils. Therefore, activation of the TLR pathway in neutrophils and MEC, combined with activation of the vitamin D pathway in macrophages, may serve to boost the innate defense system of the udder.

Key Words: vitamin D, innate immunity, mammary