The effects of vanilla flavoring in calf starter on calf starter intake. A. Tomei* and S. Kehoe, University of Wisconsin-River Falls, River Falls, WI.

Calf starter is necessary for the proper development of the rumen in young calves. Calves are born as pre-ruminants. In the beginning of their lives, they will depend on milk to meet their nutrient demands. Calf starter is the next step in preparing the calf for consumption of solid feed. The physical form of calf starter and the nutrition provided in the calf starter both have an impact on the development of a calf. The objective of this experiment was to increase the palatability of calf starter through a flavor additive such as vanilla, and evaluate whether there would be a concurrent increase in consumption of calf starter. From the University of Wisconsin-River Falls, 9 calves were utilized on the dairy operation. Calf starter intake was measured for 5 d in all calves, then the treatment was changed to add vanilla to the calf starter and measure intake for 5 d. This repeated from d 20–45 of life, making each calf its own control. The treatments were vanilla added or no vanilla added and alternated every 5 d. Vanilla was added to the calf starter at 5% of calf starter weight. Data was analyzed using the Mixed procedure of SAS (2014) using calf as a random measure and day as repeated measure.

Over the entire trial period, calf starter intake least squares means for vanilla were 250.18 and 202.60 without vanilla (SEM = 47.98, 52.42; P = 0.25). Least squares means of calf starter intake for day one through 5 for vanilla treatment were 240.72, 233.43, 211.54, 226.82, 396.12, respectively. Least squares means of calf starter intake for d 1 through 5 for no vanilla treatment were 265.09, 202.94, 228.33, 169.04, 162.53, respectively. The addition of vanilla extract to calf starter did not significantly affect starter intake. However, a numerical increase was seen in starter intake that contained vanilla flavoring. More research is needed with an increased number of calves.

Key Words: calf, starter, palatability

Economic analysis of feeding costs for diets including corn silage or sorghum silage as the main forage source. E. S. Richardson* and G. Ferreira, Department of Dairy Science, Virginia Tech, Blacksburg, VA.

The objective of this study was to evaluate the cost of diets for high-producing cows including either corn silage (CS) or sorghum silage (SS) as the main forage source. A database was generated for the nutritional composition of SS, and included: dry matter (DM; n = 22), ash (n = 16), crude protein (CP; n = 23), ether extract (EE; n = 13), neutral detergent fiber (NDF; n = 25), acid detergent fiber (ADF; n = 21), acid detergent lignin (ADL; n = 18), starch (n = 11), and in vitro dry matter digestibility (IVDMD; n = 5). The nutritional composition of CS was obtained from the dairy NRC (2001). Diets were formulated with CPM Dairy Ration Analyzer using least cost optimization. Diets were formulated for a 635-kg Holstein cow producing 40 kg of milk (3.5% fat, 3.1% protein). Formulation constraints included 100% of predicted DM intake, 100 to 110% of metabolizable energy requirement, 95 to 103% of metabolizable protein requirement, 28 to 33% dietary NDF, 30 to 40% dietary non-fiber carbohydrates, and 50 to 60% dietary fiber. Ration formulation was performed under 7 scenarios (Table 1): very low, low, middle, and high grain prices, and considering the price of SS to be either 85, 70, or 55% of the price of CS. When the price of SS was 85% of that of corn, it was cheaper to include CS in the diets, likely explained by the greater inclusion of expensive grain in diets including SS. When the price of SS was 70% of that of CS, marginal differences in diet costs were observed between CS and SS. When the price of SS was 55% of that of corn, it was more expensive to include SS in the diets. In conclusion, SS had to be 30% cheaper than CS to obtain diets of similar composition and cost.

Key Words: corn silage, sorghum silage, economic analysis

Comparison of two housing systems and dairy calf physiological responses during hot weather. H. A. Young*, A. Adams Progar, and A. Lopez Ayala, Washington State University, Pullman, WA.

Dairy calves are susceptible to heat stress when environmental temperatures exceed 68°F. Heat stress conditions cause decreases in feed intake and calf health. The objective of this study was to compare the behavior and well-being of Holstein heifer calves housed in 2 different housing systems during hot weather. This study was conducted over the course of 2 summers (Trial 1 and Trial 2). At the age of 24 - 48 h, calves were assigned to one of 2 treatments: 1) housed in stalls in a barn (S; n = 14) or 2) housed in hutches placed outside (H; n = 8). Each calf was observed until weaning at 42 d of age. Temperature and relative humidity within the housing systems were recorded at 1-h intervals using data loggers (HOBO) and used to calculate the temperature humidity index (THI). Calf body temperatures were measured hourly using temperature recording devices (iButton). Calf BW were measured weekly and ADG was calculated. Blood samples were collected at 7, 24, and 42 d of age via jugular venipuncture and analyzed for thyroxine concentrations using enzyme-linked immunosorbent assays. Data were analyzed using Pearson correlations and mixed model ANOVAs with repeated measures. No differences between trials were detected so data were combined. The THI was significantly lower in hutches (63.79 ± 0.20) than in stalls (66.44 ± 0.16; P < 0.0001). Calves housed in hutches had higher body temperatures (S: 38.59 ± 0.008°C; H: 38.92 ± 0.01°C; P < 0.0001), ADG (S: 0.6 ± 0.04 kg/d; H: 1.1 ± 0.06 kg/d; P < 0.0001), and

| Table 1 (abstract M44). Daily costs of diets including corn silage (CS) or sorghum silage (SS) as affected by corn grain prices and the relative silage prices |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                 | CS price        | SS price        | CS price        | SS price        | CS price        | SS price        | CS price        | SS price        |
| Corn grain      | Diet cost       | Diet cost       | Diet cost       | Diet cost       | Diet cost       | Diet cost       | Diet cost       | Diet cost       |
| $2.7/bu         | $27/ton         | $3.87/d         | $23/ton         | $3.99/d         | $19/ton         | $3.89/d         | $15/ton         | $3.80/d         |
| $3.7/bu         | $37/ton         | $5.36/d         | $31/ton         | $5.50/d         | $26/ton         | $5.39/d         | $20/ton         | $5.24/d         |
| $5.8/bu         | $58/ton         | $8.31/d         | $49/ton         | $8.56/d         | $41/ton         | $8.37/d         | $32/ton         | $8.16/d         |
tended to have higher plasma thyroxine concentrations (S: 15.83 µg/dL; H: 16.37 ± 0.22 µg/dL; \( P = 0.08 \)) than calves housed in stalls. Although the THI was lower in hutches than in stalls, calves housed in hutches had higher body temperatures, but these effects did not negatively impact calf growth. Future studies may investigate how calf behavior is affected by hot weather in these housing systems.

**Key Words:** calf body temperature, heat stress, thyroxine

### M46 Coordinated response of hepatic lipolysis during the transition to lactation in dairy cows


Negative energy balance, subsequent rapid mobilization of triglycerides (TG), and accumulation of excess TG within the liver are characteristic of the transition to lactation period in dairy cattle. The objective of this study was to examine the coordinated response of hepatic lipolysis-associated proteins during the transition to lactation. Liver biopsies were collected at \(-14, +1, +14\) d relative to calving (DRTC) from multiparous cows. Liver TG were quantified and used to retrospectively assign cows to either a high (>20% liver lipids, dry matter; \( n = 5 \)) or low (<20% liver lipids, dry matter; \( n = 3 \)) treatment based on the maximal liver TG concentration. Protein abundance of hepatic hydrolydrolase domain containing 5 (ABHD5), hormone sensitive lipase (HSL), lipase A and C (LIPA, LIPC), lipoprotein lipase (LPL), perilipin 1 (PLIN), patatin-like phospholipase domain containing 2 and 3 (PNPLA2, PNPLA3) were determined through Western blot analysis and normalized to total lane protein. For analysis, each lipase was expressed relative to \(-14\) DRTC and transformed as log(relative abundance +1) because data were not normally distributed. Data were analyzed for main effects of treatment, DRTC, and treatment × DRTC using PROC MIXED (SAS 9.4). Differences were declared at \( P < 0.1 \) and tendencies at \( P < 0.15 \). Cows with lower liver TG had greater ABHD5 (\( P = 0.05 \)) and HSL (\( P = 0.049 \)), and tended to have greater LIPA (\( P = 0.146 \)), LPL (\( P = 0.11 \)), and PHSN (\( P = 0.12 \)) abundance compared with cows with high liver lipids. Abundance of ABHD5 tended to be greater (\( P = 0.13 \)) and PLIN was greater (\( P = 0.06 \)) at +14 compared with \(-14 \) and +1 DRTC. Abundances of LIPA (\( P = 0.0006 \)) and PNPLA3 (\( P = 0.04 \)) were decreased at +1 and then increased by 3.3 and 1.8 times by +14 DRTC, respectively. These data indicate that cows with lower liver TG postpartum had a greater abundance of some hepatic lipases while other hepatic lipases are increased postpartum regardless of liver TG concentration. This suggests that there may be a coordinated response of several hepatic lipases to mediate both liver TG accumulation and subsequent remobilization during fatty liver recovery.

**Key Words:** lipolysis, transition cow, fatty liver syndrome

### M47 Production responses to supplementation with rumen-protected lysine and two sources of rumen-protected methionine in Holstein cows

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Multiparous Holstein cows (\( n = 57 \)) averaging 124 DIM at the start of the experiment were used to determine production responses to supplementation with rumen-protected Lys and 2 forms of rumen-protected Met. Following a 2-wk covariate period, cows were assigned to one of 3 treatments in a completely randomized design. Treatments were formulated using the Cornell Net Carbohydrate and Protein System (version 6.5.5) and consisted of control [C; Met at 2.30% of metabolizable protein (MP) supply and 0.98 g MP-Met/Mcal of metabolizable energy (ME); Lys at 6.68% of MP and 2.85 g MP-Lys/Mcal of ME]; AA-S [Met at 2.66% of MP and 1.14 g MP-Met/Mcal of ME; Lys at 7.16% of MP and 3.08 g MP-Lys/Mcal of ME]; and AA-M [Met at 2.66% of MP and 1.14 g MP-Met/Mcal of ME; Lys at 7.16% of MP and 3.07 g MP-Lys/Mcal of ME]. Lysine was supplemented to AA-S and AA-M using USA Lysine (Kemin Industries, Des Moines, IA). Methionine was supplemented to AA-S using Smartamine-M (Adisseo, Alpharetta, GA) and to AA-M using MetiPEARL (Kemin Industries, Des Moines, IA). Data were analyzed using the MIXED procedure of SAS (SAS Institute, Inc. Cary, NC) with repeated measures. Contrasts consisted of AA (control vs. both AA treatments) and Met (AA-S vs. AA-M). Dry matter intake (26.0, 25.8, and 25.5 kg/d for C, AA-S, and AA-M, respectively; \( P = 0.54 \)) and milk yield (45.0, 44.5, and 44.9 kg/d; \( P = 0.84 \)) were not different among treatments. Milk true protein percentage (2.92, 2.92, and 2.98%) was increased (\( P = 0.01 \)) for cows fed AA-S and AA-M compared with controls, but was not different between AA-S and AA-M (\( P = 0.81 \)). Yield of milk protein (1.32, 1.32, and 1.35 kg/d; \( P = 0.58 \)) was not different among treatments. Percentages (3.46, 3.56, and 3.51%; \( P = 0.54 \)) and yields (1.56, 1.57, and 1.59 kg/d; \( P = 0.82 \)) of milk fat and yields of energy-corrected milk yield (45.3, 45.0, and 45.7 kg/d; \( P = 0.75 \)) were not different among treatments. Supplementation of AA increased milk true protein percentage but did not affect yields of milk and milk components; responses were the same between the 2 forms of rumen-protected Met used in this experiment.

**Key Words:** methionine, lysine, milk protein

### M48 Formation and characterizations of heated whey protein isolate and alginate complexes

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With increasing interest for clean-label products, there is a need to develop protein ingredients with improved functional properties. Forming protein-polysaccharide electrostatic complexes has been found to improve protein functionalities. Most studies focus on complexation at pH < pl and low biopolymer concentrations. The purpose of this study was to develop and characterize heated whey protein-alginate complexes (H-CPX) formed by heating mixed solutions of 1–5% whey protein isolate (WPI) and alginate (0–1%) at pH 6.0 at 85°C for 30 min. Characterizations of H-CPX included measuring particle size, zeta potential and rheological properties as well as turbidity observation. Results showed that, across all WPI concentrations, average mean diameters of H-CPX significantly decreased (\( P < 0.05 \)) with increasing alginate concentration until reaching a minimum and then increased. This corresponded to the change in turbidity of the H-CPX. Zeta potential results revealed that increasing alginate concentration led to the formation of H-CPX with higher negative charge, suggesting that more alginate was incorporated into the electrostatic complexes. At similar alginate concentrations, higher WPI concentration resulted in complexes with larger aggregate sizes but lower negative charge than those of H-CPX formed at lower WPI concentration. This indicated a limited degree of complexation. H-CPX formed at 1% WPI showed Newtonian behavior while those at 3% WPI showed pseudoplastic behavior. This corresponded to the change in turbidity of the H-CPX. Zeta potential results revealed that increasing alginate concentration led to the formation of H-CPX with higher negative charge, suggesting that more alginate was incorporated into the electrostatic complexes. At similar alginate concentrations, higher WPI concentration resulted in complexes with larger aggregate sizes but lower negative charge than those of H-CPX formed at lower WPI concentration. This indicated a limited degree of complexation. H-CPX formed at 1% WPI showed Newtonian behavior while those at 3% WPI showed pseudoplastic behavior.
Heated whey protein and pectin complexes formed at near neutral pH and high protein ratio are being developed in our laboratory. These complexes have higher negative charge and can potentially be used as emulsifier and stabilizer in clean-label applications. The objective of this study was to assess the emulsification properties of heated whey protein and pectin complex (HCPX) in O/W emulsions at pH 3.5–7 based on a wide pH range of food products. HCPX was prepared by heating mixed solution of 3% whey protein isolate and 0.3% low methoxy pectin at pH 6.2 and at 85°C for 15 min. Emulsions (containing 5% oil and 2% protein) were prepared by homogenizing the aqueous solutions with oil, followed by ultrasonic processing. The pH of the emulsions was adjusted to 4.0–7.0 and the droplet size, zeta potential, and rheological properties were measured. Emulsion stability was determined by measuring creaming on day 1 and 7. For pH 3.5, emulsions were formed by adjusting the pH of the aqueous solution to 3.5 before oil addition and emulsification. Emulsification properties of HCPX were compared with heated WPI without pectin (CONTROL). Results showed that, CONTROL formed stable emulsions without creaming at pH 4.0, 6.0 and 7.0; however, emulsions at pH 4.5, 5.0, and 5.5 separated into 2 layers on Day 1. HCPX formed stable emulsions across pH range of 4.0 to 7.0 and no creaming was observed on Day 7. At pH 4.5, 5.0 and 5.5, emulsions stabilized by HCPX had significantly smaller droplet sizes and larger zeta potential (P < 0.05) compared with those stabilized by CONTROL. Since pH 3.5 is below the pl of the whey protein emulsions were formed by adjusting the pH of the aqueous solution before emulsification. This approach also led to stable emulsion (e.g., no creaming on Day 7) when HCPX was used. Rheological results revealed that improved stability of HCPX-stabilized emulsions could be partly due to an increase in viscosity. It can be concluded that HCPX could be used to emulsify and stabilize the emulsions in a wide pH range. The major benefit of the HCPX is the significant improvement in emulsification properties at pH near pl. HCPX can be developed as WPI-based emulsifier and stabilizer for clean-label applications.

Key Words: whey protein isolate, pectin, emulsification

M50 Evaluating teat skin condition in response to phenoxyethanol as a post-milk-disinfectant on lactating dairy cows. S. K. Reeves*, M. R. Borchers, and J. M. Bewley, Department of Animal and Food Sciences, University of Kentucky, Lexington, KY.

Alternatives to iodine-based teat dips may decrease risk of iodine residues in milk. The objective of this study was to evaluate how a post-milk teat dip containing phenoxyethanol as the active ingredient and a 5% emollient (treatment) affected teat end condition compared with a 1% iodine solution (control). A 9-wk, split-udder, non-inferiority study was conducted on 111 lactating Holstein dairy cows at the University of Kentucky Coldstream Research Dairy. The treatment (left side) and control (right side) were applied using a non-return dip cup. Teats were scored once a week, in accordance with NMC guidelines, for 9 weeks on a 1 (desirable) to 3 (undesirable) scale for teat skin chapping, teat skin dryness, and teat skin color. A 1 (desirable) to 4 (undesirable) scale was used for teat end condition. Data analyses were conducted with SAS Version 9.3 (SAS Institute Inc., Cary, NC). The FREQ procedure generated frequency distributions and the MIXED procedure generated a mixed linear model evaluating the effect of teat, week, and their interaction on teat end condition, teat skin color, teat skin chapping, and teat skin dryness. Teat skin chapping and teat skin color remained at a score of 1 throughout all 9 weeks of the study and were not analyzed further. For teat end condition, no significant differences in scores between treatment teats and control teats. For teat dryness, scores for treatment front teats were significantly greater than control front teats (1.10 ± 0.01 vs. 1.06 ± 0.01; P ≤ 0.001). Temporary increases in dryness scores during study wk 4, 5, 6, and 9 (P ≤ 0.01) on the treatment side occurred during expected teat exfoliation. The scores comparing treatment and control teats are significantly different, but are minimal enough that they do not suggest a biological difference. Results indicate phenoxyethanol may serve as an alternative to iodine-based teat dips, which raise a risk of milk iodine residues.

Key Words: post-dip, teat condition, split udder dairy model


Group calving pens are becoming more common in dairy management practices, especially in larger herds. This is beneficial since less area is required compared with individual calving pens. The latest USDA NAHMS survey of US dairy farms reported that 58.7% of herds have at least some cows calving in a group pen. It is predicted that multiple cows in a maternity pen may be disruptive to the cow in labor and therefore negatively affect partition. The objective of this research was to describe the behavior of Holstein and Jersey dairy cows in a group maternity pen at the time of calving. Cows were moved to the maternity pen 3 weeks before their due date. A total of 17 cows (n = 9, Jersey and n = 8, Holstein cows) were monitored from the time of calving through the following hour. Holstein and Jersey cows were grouped together but multiparous and primiparous cows were in separate pens. Observations obtained from video recordings included, 1) time of calving, 2) stocking density at the time of calving (# cows / pen), 3) time to first interaction of the community cows with both mother and calf, 4) degree of calving difficulty (assisted vs. no assistance). There was no difference in the proportion of Jersey cows calving in the PM hours compared with Holstein cows (78% vs. 62%, respectively; P = 0.27). The highest stocking density recorded was 15 cows/pen. No correlation was detected between stocking density and time to first interaction with cow or calf (r = 0.34, y = 0.196+9.177; P = 0.33). Only 2 events of dystocia occurred in this sample, one at a low stocking density (4 cows/pen) and one at a high stocking density (14 cows/pen); more data is required to investigate the link between stocking density in maternity pens and dystocia. This research will give insight on whether group pens are disruptive to the calving event and if dairy practices should be changed to allow for less stressful calving for both the mothers and calves.

Key Words: stocking density, calving, group pens

M52 Relationship of body condition changes during the first 30 d of lactation and pregnancy rate per AI at 75 to 81 DIM. E. L. Middleton* and J. R. Pursley, Michigan State University, East Lansing, MI.

The objective of this experiment was to determine the relationship between body condition changes during the 1st 30 d of lactation and the chances of pregnancy following 1st AI in lactating dairy cows. All cows were assigned a body condition score (BCS) value on a 1 to 5 scale (in tenths) within 1 week of calving and 30 d following calving. All cows received timed-AI using G6G/Ovsynch at 75 to 81 DIM. Cows were diagnosed for pregnancy using ultrasonography 35 d following 1st AI. Body condition loss during the 1st 30 d of lactation was greater for 1st
and 3rd compared with 2nd parity cows (−0.26 ± 0.01 and −0.26 ± 0.02 vs −0.15 ± 0.01; n = 736). A greater % of 2nd parity cows maintained or gained BCS during the measurement period compared with 1st and 3rd+ parity cows (32 vs. 14 and 19%; n = 736). In 1st and 2nd parity cows there was a significant negative relationship between BCS loss in the 30 d period following calving and chances of pregnancy later in lactation. Cows with the least loss had the greatest pregnancies per AI. There was no relationship between BCS loss and chances for pregnancy in 3rd + parity cows. One of the best predictors for fertility was previous calving interval. Quartiles of cows with a previous calving interval between 343 and 362 and 363 to 407 DIM had less mean ± SEM BCS loss compared with cows that had 408 to 433 and 434 to 619 DIM in previous calving interval (−0.14 ± 0.01, −0.19 ± 0.02, −0.22 ± 0.02 and −0.30 ± 0.03; n = 736), a greater % of cows that maintained or gained during the 30d period (34 vs. 22 vs. 17 vs. 14%; n = 736) and a greater chance for pregnancy at 1st AI (41, 46, 33, and 31%; n = 316).

In summary, cows with the least amount of BCS loss between calving and 30 d post-calving had greater fertility following timed-AI at 75 to 81 DIM. Previous calving interval was predictive of BCS loss and future level of fertility.

Key Words: body condition loss, fertility, dairy cow

M53  Flaxseed containing lipid supplement increases linearly omega-3 content in milk without compromising production parameters. S. Akers*1, R. Wilson1, K. Swanson1, M. Keller1, L. Goddick1, G. Cherian1, R. Day2, and G. Bobe1, 1Oregon State University, Corvallis, OR, 2N3Feed, Tualatin, OR.

Health and nutrition professionals advise consumers to limit consumption of saturated FAs and increase consumption of foods rich in omega-3 FAs. We showed that feeding 3 kg of the flaxseed containing lipid supplement 12BT40 (N3Feed LLC; Tualatin, OR) increases omega-3 content in milk compared with its ground, unprocessed ingredients by protecting omega-3 FAs from ruminal biohydrogenation. To determine the optimal supplementation rate of 12BT40 for improving milk fatty acid profile without adversely affecting production parameters, we fed 6 mid- to late-lactation, pregnant Holstein cows (1 block each for primiparous and multiparous cows) for 6 weeks consecutively 0 (Control; 1 week), 0.91 (1 week), 1.81 (2 weeks), and 2.72 kg/d (2 weeks) 12BT40 as top-dressing. Milk and serum samples were collected at the end of each treatment period and analyzed for fatty acid profile and metabolic indicators, respectively. Individual feed intake and milk yield and components were measured to evaluate the effect of 12BT40 on production characteristics. Data were analyzed using PROC MIXED in SAS version 9.4. Fixed effects were supplementation rate (linear, quadratic and cubic) and parity; cow was the random effect. 12BT40 supplementation rates increased linearly (PLinear < 0.0001) the omega-3 proportion in milk FAs (0.48, 1.92, 2.53, and 3.67 ± 0.30wt% for 0, 0.91, 1.81, and 2.72 kg/d of 12BT40) whereas the proportion of artherogenic 12:0, 14:0 and 16:0 was decreased (51.2, 41.1, 38.6, and 34.1 ± 1.0wt% for 0, 0.91, 1.81, and 2.72 kg/d of 12BT40; PLinear < 0.0001). 12BT40 supplementation rates increased linearly (PLinear = 0.009) milk yield (20.7, 20.9, 21.4, and 22.8 ± 1.3 kg/d for 0, 0.91, 1.81, and 2.72 kg/d of 12BT40) and had curvilinear relations with DMI (18.4, 17.5, 16.5, and 20.9 ± 0.6 kg/d for 0, 0.91, 1.81, and 2.72 kg/d of 12BT40) and milk fat content (3.96, 4.11, 4.69, and 4.06 ± 0.23% for 0, 0.91, 1.81, and 2.72 kg/d of 12BT40). Based on these results, we conclude that feeding up to 2.72 kg/d 12BT40 may improve milk fatty acid profiles without compromising production parameters.

Key Words: flaxseed, lipid supplement, omega-3