211 Effects of precision feeding Holstein and Jersey heifers—a gradual increase of dietary poultry fat on nutrient digestibility, S. M. Hussein*, S. Twyman¹, M. Toledo¹, O. Thomas¹, J. Echessabal², R. M. Stockler³, M. J. Aguerre¹, and G. J. Lascano¹, ¹Clemson University, Clemson, SC, ²Auburn University, Auburn, AL, ³Dairyland Laboratories Inc, Belleville, WI.

The term “precision-feeding” refers to a program that provides heifers with the correct amount of nutrients necessary for adequate growth without affecting future performance. Including poultry fat (PF) can accurately meet caloric requirements and reduce dry matter intake (DMI) when diets are isocaloric and isonitrogenous. However, high fat intake may lead to reduction in fiber digestibility and inadequate rumen fermentation. Yet, reduction of DMI as PF is incorporated into diets can provide similar energy to the animal limiting the negative effects associated with fat inclusion. The objective of this study was to evaluate the effects on nutrient digestion of including different levels of PF inclusion in precision feeding dairy heifers. We hypothesized that including PF would further reduce intake without compromising nutrient digestibility in dairy heifers. Treatments included 55% forage diet with 4 levels of PF inclusion starting with a basal concentration of fat in the diet [3% fat (0% PF); 5% fat (2% PF); 7% fat (4% PF); and 9% fat (6% PF)]. Holstein and Jersey heifers were randomly assigned to treatments and administered according to a split-plot, 4 x 4 Latin square design (21-d periods). Data were analyzed using the MIXED procedure of SAS. There were no differences on OM apparent digestibility coefficients (dc) between the Holstein and Jersey-group. However, NDF dc was higher (P < 0.01) in Holstein heifers (68.40 vs. 61.34 ± 1.2%), but the Jersey-group had higher ADF (34.15 vs. 44.58 ± 1.6%), and N dc (90.01 vs. 92.04 ± 0.3%). The inclusion of PF did not affect OM, NDF, and ADF dc. However, the EE and N dc increased linearly with the increased level of PF inclusion. The Holstein-group spent more time to finish their meal (P < 0.05) than the Jersey-group (65.33 vs. 59.94 ± 1.6 min), and the PF inclusion showed a linear decrease in the time spent to finish the meal. These results suggest that Holstein utilized NDF more efficiently. In the current study, increasing dietary PF inclusion up to 9% DM reduced DMI without affecting OM and fiber digestibility but increased EE and N dc.

Key Words: precision feeding, poultry fat, heifer

212 In vitro gas production detected differences among corn hybrids at silage maturities, N. Schlau¹, D. R. Mertens², and D. Taysom¹, ¹Dairyland Laboratories Inc, Arcadia, WI, ²Mertens Innovation and Research LLC, Belleville, WI.

In vitro starch disappearance (after 7–9 h) is used to detect differences among corn hybrids in mature grains; however, it is not effective for corn silages (CS). This may be due to differences in the zein matrix in immature vs. mature corn combined with drying and grinding samples for analysis. The objective was to determine whether differences can be detected among corn hybrids at silage maturities if the kernels are quartered to eliminate the effects of drying and grinding. Ears of Mycogen hybrids (7-2F2F499 (B), 6-TMF2Q419 (C), and 7-UNI95D58 (FL), with branched fatty acid profile in milk fat from dairy cows. 1. M. dos Santos Neto*, J. M. de Souza², A. M. Burch¹, and A. L. Lock¹, ¹Michigan State University, East Lansing, MI, ²Perdue Agribusiness, Salisbury, MD.

We performed a meta-analysis to evaluate the effects of altering the dietary ratio of C16:0 and cis-9 C18:1 on production and energetic responses of lactating dairy cows. Treatments were: 1) CON (control); non-FA supplemented diet); 2) 80:10 (FA supplement blend with 80% C16:0 + 10% cis-9 C18:1 fed at 1.5% diet DM); and 3) 60:30 (FA supplement blend with 60% C16:0 + 30% cis-9 C18:1 fed at 1.5% diet DM). A meta-regression evaluated the relationships of insulin with energy output to milk and to BW. The data set was assembled from individual observations of 316 Holstein cows from 5 studies at Michigan State University with 80:10 (n = 113) and 60:30 (n = 113) compared with CON (n = 87). The meta-analysis was performed using the PROC MIXED of SAS, including study as random effect. Compared with CON, 80:10 did not affect DMI (P = 0.26), plasma insulin concentration (P = 0.14), BW gain (P = 0.23), or energy output to BW (P = 0.79), and increased milk yield (2.8 kg/d, P = 0.02), milk fat yield (0.13 kg/d, P = 0.01), ECM (3.16 kg/d, P < 0.01), milk fat content (0.26%, P < 0.01), and milk energy output (2.02 Mcal/d, P = 0.01). Compared with CON, 60:30 did not affect DMI (P = 0.79), tended to increase BW gain (0.21 kg/d, P = 0.08), increased energy output to BW (1.53 Mcal/kg, P = 0.05), plasma insulin concentration (0.06 μg/L, P = 0.01), milk yield (2.27 kg/d, P = 0.05), milk fat yield (0.12 kg/d, P = 0.01), ECM (3.03 kg/d, P < 0.01), and milk fat content (0.26%, P < 0.01). Plasma insulin concentration had a negative linear effect on energy output to milk (38.6 ± 1.61 -7.63 ± 1.74x, P < 0.01; RMSE = 1.48), and a positive quadratic effect on energy output to BW (−10.0 ± 3.63 + 28.6 ± 7.86x−15.2 ± 4.71x², P < 0.01; RMSE = 1.85). In conclusion, feeding FA blends between 80:10 and 60:30 increased the yields of milk, milk fat, and ECM compared with CON. Increasing dietary cis-9 C18:1 increased plasma insulin concentration, with plasma insulin concentration having a positive relationship with energy output to BW. Altering the dietary ratio of C16:0 and cis-9 C18:1 may be a useful strategy to change nutrient partitioning in dairy cows.

Key Words: insulin, oleic acid, palmitic acid

214 The effects of parity and stage of lactation on odd- and branched-fatty acid profile in milk fat from dairy cows. L. L. Sun¹, L. Lei², J. T. Brenna¹, Z. H. Wu¹, L. Ma¹, J. C. Xu¹, and D. P. Bu¹*, ¹State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China, ²Hunan Agricultural University, Hunan, China, ³Dell Pediatric Research Institute and Departments of Nutrition and of Chemistry, University of Texas at Austin, Austin, TX, 4Key Laboratory of Economic Plants and Biotechnology, Kunming Institute of Botany, Chinese Academy of Sciences, Kunming, China, 5Hunan Agricultural University, Hunan, China.

We performed a meta-analysis to evaluate the effects of altering the dietary ratio of C16:0 and cis-9 C18:1 on production and energetic responses of lactating dairy cows. The data set was assembled from individual observations of 316 Holstein cows from 5 studies at Michigan State University with 80:10 (n = 113) and 60:30 (n = 113) compared with CON (n = 87). The meta-analysis was performed using the PROC MIXED of SAS, including study as random effect. Compared with CON, 80:10 did not affect DMI (P = 0.26), plasma insulin concentration (P = 0.14), BW gain (P = 0.23), or energy output to BW (P = 0.79), and increased milk yield (2.8 kg/d, P = 0.02), milk fat yield (0.13 kg/d, P = 0.01), ECM (3.16 kg/d, P < 0.01), milk fat content (0.26%, P < 0.01), and milk energy output (2.02 Mcal/d, P = 0.01). Compared with CON, 60:30 did not affect DMI (P = 0.79), tended to increase BW gain (0.21 kg/d, P = 0.08), increased energy output to BW (1.53 Mcal/kg, P = 0.05), plasma insulin concentration (0.06 μg/L, P = 0.01), milk yield (2.27 kg/d, P = 0.05), milk fat yield (0.12 kg/d, P = 0.01), ECM (3.03 kg/d, P < 0.01), and milk fat content (0.26%, P < 0.01). Plasma insulin concentration had a negative linear effect on energy output to milk (38.6 ± 1.61 -7.63 ± 1.74x, P < 0.01; RMSE = 1.48), and a positive quadratic effect on energy output to BW (−10.0 ± 3.63 + 28.6 ± 7.86x−15.2 ± 4.71x², P < 0.01; RMSE = 1.85). In conclusion, feeding FA blends between 80:10 and 60:30 increased the yields of milk, milk fat, and ECM compared with CON. Increasing dietary cis-9 C18:1 increased plasma insulin concentration, with plasma insulin concentration having a positive relationship with energy output to BW. Altering the dietary ratio of C16:0 and cis-9 C18:1 may be a useful strategy to change nutrient partitioning in dairy cows.

Key Words: insulin, oleic acid, palmitic acid
Dairy products are the main source of odd- and branched-fatty acids (OBCFA) in the Western diet, a group of nutrients with emerging health benefits. Animal diet is known to have important influence on milk fat OBCFA; however, effects of physiological factors have received little attention. The objectives of our study were to examine the effects of parity and stage of lactation on OBCFA profiles in milk fat from Holstein dairy cows, and further to investigate the relationship between OBCFA profiles and yield of milk and milk fat. Holstein dairy cows (n = 184) with an average parity of 2.8 ± 0.3 and 173 ± 24 d in milk (DIM) were selected. All cows were fed the same diet, and milk samples were collected on the same day to avoid the effects of diet and season factors. Fatty acid methyl esters contents were analyzed by gas chromatography. A regression model was developed by linear model procedure (PROC GLM) of SAS to analyze the data, and the relationships between OBCFA profiles and yield of milk and milk fat were analyzed by correlation procedure (PROC CORR). Frequency distributions demonstrated that milk fat content of iso-15:0, iso-17:0, anteiso-15:0 and anteiso-17:0 varied 3.4-fold among individuals. Parity and DIM accounted for less than 25% of total individual variation of OBCFAs, except for n-15:0 (26.8%). Parity and DIM had significant effects on some OBCFAs, including n-15:0 (P < 0.001), iso-13:0 (P < 0.01), iso-15:0 (P < 0.01), iso-17:0 (P < 0.001), anteiso-15:0 (P < 0.01), and anteiso-17:0 (P < 0.01). Negative correlations existed between n-13:0 (r = −0.22, P < 0.03), iso-14:0 (r = −0.21, P < 0.03), and iso-16:0 (r = −0.22, P = 0.03) and yield of milk and milk fat. There were no relationships between milk yield or milk fat and other OBCFAs of Holstein dairy cows.

**Key Words:** dairy cow, odd- and branched-chain fatty acid, parity

### 215 Profiles of odd- and branched-chain fatty acids in bovine colostrum and transition milk. H. S. Xin1,2, Y. Xu1, Y. H. Chen2, G. Chen1, and L. L. Guan*1,3; 1College of Animal Science and Technology, Northeast Agricultural University, Harbin, Heilongjiang, China, 2Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, Alberta, Canada.

Odds- and branched-chain fatty acids (OBCFAs) including iso-C14:0, iso-C15:0, anteiso-C15:0, iso-C16:0, iso-C17:0, anteiso-C17:0 and iso-C18:0 are found in bovine milk and have been reported to have positive influences on human health. However, it is unknown whether they are also present in colostrum and transition milk, which are used to feed neonatal calves and are potential bioactive compounds impacting calf gut health. Therefore, this study aimed to investigate OBCFA profiles in colostrum and transition milk. All samples were collected from a total of 12 Holstein dairy cows (6 primiparous and 6 multiparous) on the 1st day (colostrum, within 0.5 h), 3rd day (transition milk) and 5th day (milk) after calving, respectively. The OBCFA profiles of the milk samples were measured with gas chromatography and the effect of milk type on OBCFA was analyzed using the PROC MIXED procedure in SAS 9.4 (SAS Institute, Cary, NC). The total OBCFA content was 134 mg/100g milk in the colostrum, which was 24% and 35% lower (P < 0.05) than that in the transition milk and milk, respectively. Similar findings were found on the contents of total iso-OBCFAs, total anteiso-OBCFAs, total odd-OBCFAs, total even-OBCFAs as well as total BCFA. As for the individual OBCFA profiles, straight-chain fatty acids C15:0 and C17:0 were the top 2 abundant OBCFA in all milk types, accounting for 20–25% and 21–24% of the total OBCFAs, respectively. The proportions of iso-C14:0, anteiso-C15:0, iso-C16:0, iso-C17:0, anteiso-C17:0 and iso-C18:0 were the lowest (P < 0.05) in the colostrum, followed by the transition milk and milk, while the proportions of iso-C15:0 and C15:0 were the highest in the colostrum, followed by the transition milk and milk. No difference was observed on iso-C18:0 proportion among 3 milk types. In summary, the results indicated that colostrum, transition milk and milk had different OBCFAs contents and profiles with the total OBCFA content being lower in colostrum, compared with transition milk and milk samples. Whether these differences play a role in calf health warrants future studies.

**Key Words:** odd- and branched-chain fatty acids, colostrum, transition milk

### 216 Effect of a low forage diet on the yields of milk and milk components and feed efficiency of mid-lactation dairy cows. A. N. Negreiro* and A. L. Lock, Michigan State University, East Lansing, MI.

Examining the effect of lower forage diets and alternative fiber sources in lactating dairy cow diets is important since forage quality and quantity can vary greatly depending on growing conditions, years, and locations. Therefore, we determined the effect of feeding diets similar in NDF, starch, and CP with differing amounts of forage on the yields of milk and milk components of mid-lactation dairy cows. Thirty-two Holstein cows (132 ± 68 DIM) were used in a crossover design with 2 consecutive 28-d periods, with sample and data collection during the final 5 d of each period. Treatment diets were: 1) control diet (CON) containing high forage (51.4% diet DM; forage NDF 18% diet DM) and no supplemental fat or supplemental amino acids (RUP 6.67% diet DM; RDP 10.4% diet DM); and 2) low forage diet (LF) containing low forage (31.6% diet DM; forage NDF 11.2% diet DM), including supplemental fat (1.5% diet DM, 82% C16:0-enriched supplement) and supplemental amino acids (RUP 7.01% diet DM; RDP 9.69% diet DM). Diets were balanced for similar NDF (29% diet DM), starch (26.5% diet DM), and CP (16.9% diet DM). The statistical model included the random effect of cow and fixed effects of diet, period, and their interaction. Results are presented in the sequence CON vs LF. There was no effect of treatment on milk yield (45.4 vs 46.1 kg/d, P = 0.34), milk fat content (3.95% vs 3.99%, P = 0.38), or BW (704 vs 703 kg, P = 0.83). Compared with CON, LF decreased DM (34.7 vs 28.6 kg/d, P < 0.01) and increased milk fat yield (1.78 vs 1.84 kg/d, P = 0.02), milk protein yield (1.47 vs 1.56 kg/d, P < 0.01), milk protein content (3.24% vs 3.41%, P < 0.01), ECM (48.3 vs 50.2 kg/d, P < 0.01), feed efficiency (ECM/DMI: 1.41 vs 1.77 kg/d, P < 0.01), and BCS (3.2 vs 3.3, P = 0.02). Our results demonstrate that feeding a low forage diet supplemented with amino acids and palmitic acid-enriched supplement increased feed efficiency through decreased DM and increases in the yields of milk fat and protein, without changes in BW.

**Key Words:** forage, amino acid, fatty acid

### 217 Predicting the yield of milk fat and milk fatty acid sources from fatty acid intakes in lactating dairy cows: A meta-analysis. J. M. dos Santos Neto*1, J. de Souza1, and A. L. Lock1, Michigan State University, East Lansing, MI, Perdue AgriBusiness, Salisbury, MD.

We performed a meta-analysis to evaluate the effect of intake (i) of C16:0, C18:0, C18:1, C18:2, and C18:3 on the yields of milk fat and fatty acid (FA) sources. Our analysis used 1,339 individual cow observations from 16 studies at Michigan State University. Diets (% DM) contained contained (mean ± SD) 30.1 ± 2.47 NDF, 26.6 ± 3.17 starch, and 4.03 ± 0.78 total FA. Total FA i averaged 1,126 g/d ± 296 and ranged from 308 to 2,248 g/d. Statistical analyses were performed using the PROC MIXED of SAS, including random effects of study, period within study, and cow within study. Individual FA i (g/d) were used as independent variables, the yields (g/d) of milk fat and milk FA were used as dependent variables. Independent variables were removed from the model using backward elimination with significance criteria of P > 0.10. Total FA intake was not used as an independent variable in the model to avoid multicollinearity. We classified milk FA by source as de novo (<16 carbons), mixed (16 carbons), and preformed milk FA (>16 carbons). C16:0 i linearly increased the yield of milk fat [1,552 ± 70.9 + 0.22 ± 0.01 x C16:0 i, P < 0.01; RMSE = 1.30]; C18:3 i tended to linearly decrease the yield of de novo milk FA [373 ± 18.8 - 0.04 ± 0.03 x C18:3 i, P = 0.10; RMSE = 19.3]; C16:0 i linearly increased mixed milk FA [468 ± 19.7 + 0.22 ± 0.01 x C16:0 i, P < 0.01; RMSE = 14.5], and C18:1+C18:2 i tended to linearly...
increase preformed milk FA \[486 \pm 48.9 \pm 0.33 \pm 0.12 \times C18:1\_i + 0.13 \pm 012 \times C18:2\_i, P = 0.06; \text{RMSE} = 22.4\]. C18:0 \_i had no effect on milk FA yield \(P > 0.10\). Among individual de novo milk FA, C16:0 tended to linearly decrease milk FA from 10 to 14-carbons \(P = 0.07\), had no effect on C8:0 \(P = 13\), and linearly increased the yields of C4:0 \[43.6 \pm 2.94 \pm 0.009 \pm 0.001 \times C16:0\_i, P < 0.01; \text{RMSE} = 1.61\] and C6:0 \[29.5 \pm 1.55 + 0.002 \pm 0.001 \times C16:0\_i, P = 0.02; \text{RMSE} = 0.96\]. In conclusion, the yields of milk FA by source were dependent on the profile of FA ingested. Overall, C16:0 \_i was associated with increasing milk fat yield. C16:0 increased C4:0 and C6:0, which can be associated with the role of these FA in maintaining milk fluidity, given their low melting point.

**Key Words:** fatty acid, meta-analysis, milk fat