W116  Relationship between body condition score and ultrasound measurement of backfat thickness of Holstein dairy cows in a grazing-based system. G. V. Kozlowski1, L. Wlodarski1, D. S. Zeni2, J. A. R. Rosback1, and W. M. Graf2. 1Universidade Federal de Santa Maria, Santa Maria, RS, Brazil, 2Instituto Federal Farroupilha, Santa Maria, RS, Brazil.

The body condition score (BCS) is a practice and common approach for evaluating the nutritional status of dairy cows which, however, has been questioned because of its subjectivity. Alternatively, backfat thickness (BFT) is a reliable parameter to assess the change of the energy status of dairy cows and can be objectively measured by ultrasonography. A high correlation between BCS index and BFT has been obtained in dairy cows and can be objectively measured by ultrasonography. (BFT) is a reliable parameter to assess the change of the energy status of dairy cows and can be objectively measured by ultrasonography. The minimal and maximal values of the variables were: DIM: 7 to 303; milk production (L/d): 6.3 to 36.0; BCS: 1.25 to 4.00 and BFT (mm): 2.8 to 30.4. There was a significant (P < 0.05) correlation between DIM and either BCS (r = 0.23) or BFT (r = 0.27) as well as between BCS and BFT (r = 0.33). The linear regression between BFT and BCS, which model included the cows as a random class variable, was: BFT (mm) = 2.3 + 5.2BCS (P < 0.05, RMSE = 2.79). In conclusion, in a grazing-based system where herbage allowance and quality are broadly variable throughout the year, the change in either BCS or BFT of cows was only weakly related to their lactation stage. Moreover, the change in BFT of cows was not accurately detected as a change in their BCS.

Key Words: backfat thickness, body condition score, dairy cow

W117  Effects of increasing levels of calcium soap of fatty acid supplementation on lactation performance in dairy buffaloes. Hizulrahman*1, M. Abdullah1, J. Bhatti1, T. Pasha2, M. Akhtar2, Z. Ali3, M. Saadullah1, and M. Haque2. 1Department of Livestock Production, University of Veterinary and Animal Sciences, Lahore, Punjab, Pakistan, 2Department of Animal Nutrition, University of Veterinary and Animal Sciences, Lahore, Punjab, Pakistan, 3Applied Chemistry Research Center, Pakistan Council of Scientific and Industrial Research Laboratories Complex, Lahore, Punjab, Pakistan.

The effects of feeding varying levels of Ca salts of fatty acids on production responses were less thoroughly reported in lactating dairy buffaloes compared with the dairy cow. The objective of this study was to investigate the effect of increasing level of Ca salts of palm fatty acid (Ca-FA) on dry matter intake, milk yield, milk fat, and milk fatty acid (FA) profile in lactating Nili Ravi buffalo. Twelve multiparous early-lactating Nili Ravi buffaloes received 4 treatments in a 4 x 4 Latin square design with a period length of 21-d. The 4 diets were designed to provide 0, 200, 400, and 600 g of Ca-FA per day/buffalo. Milk yield and 3.5% fat-corrected milk yield were increased by 2.00 (quadratically, P = 0.04) and 6.20% (quadratically, P < 0.01), respectively, with the increasing Ca-FA intake. However, the response was maximized with the 400 g/d of Ca-FA intake by 16.1% on 3.5% fat-corrected milk yield. Milk fat content and yield were increased by 3.20 (quadratically, P = 0.04) and 8.20% (quadratically, P = 0.01), respectively, with the Ca-FA addition. Similarly, the increase in milk fat content and yield were maximum by 7.90 and 18.9%, respectively, with the 400 g/d of Ca-FA intake. The Ca-FA supplemental levels decreased the content and yield of de novo milk FA by 21.7% (linearly, P < 0.01) and increased the content and yieldom the preformed milk FA by 10.0% (linearly, P < 0.05) and the increase in milk C16:0 content was 9.32% (linearly, P < 0.01). Milk-feed-ratio were decreased for de novo milk FA (C12:0 and C14:0), C16:0, and preformed milk FA (C18:0 and C18:1) (linearly, P < 0.01) with increasing Ca-FA intake. In conclusion, increasing Ca-FA intake increased milk and milk fat yield and responses were maximized with the 400 g/d of Ca-FA supplemental level. Data were analyzed using the GLIMMIX procedure of SAS University Edition (SAS Institute Inc., Cary, NC), with main effects of period and treatments, whereas buffaloes were designated as random effect in the model. Treatments were compared with linear and quadratic polynomial contrasts to examine the response surface for the level of Ca-FA. When a significant effect (P ≤ 0.05) of dietary treatment was observed, means were compared using the Tukey’s test.

Key Words: calcium soap, milk yield, buffalo

W118  Responses in performance and feed intake of early-lactation dairy cows supplemented with linseed oil coated with vegetable fat or extruded linseed. J. M. Ruiz-Rodriguez1, M. Puyalto2, J. J. Mallo2, G. Elcoso3, and A. Bach*4,5. 1Department of Agrarian Production, Polytechnic University of Madrid, Madrid, Spain, 2Norel S.A., Madrid, Spain, 3Blanca from the Pyrenees, Hostalets de Tost, Spain, 4Department of Ruminant Production, IRTA, Barcelona, Spain, 5Institució Catalana de Recerca i Estudis Avançats, Barcelona, Spain.

The aim of the study was to evaluate the effects of supplementing extruded linseed or linseed oil coated with hydrogenated palm fatty acid distillates (HPFAD) on DMI and milk yield of early-lactation dairy cows. Sixty-three Holstein cows (591 ± 84 kg BW, 42 ± 24.8 DIM, 37.2 ± 10.6 kg of milk/d) were randomly distributed in 3 groups (n = 21) and exposed for 84 d to 3 treatments following a complete randomized design. Treatments consisted of supplementation with 500 g/d of HPFAD (CTR), 350 g/d of extruded linseed and 390 g/d of HPFAD (EXT), or 500 g/d of HPFAD coated linseed oil (HFL). Both, HFL and EXT diets provided the same amount of linolenic acid. Cows were fed a TMR (15.5% CP, 33.7% NDF, 1.65Mcal of NEl/kg; DM basis) twice daily. On a daily basis, BW, DMI, milk yield, and milk fat and protein contents were determined individually. Animal was the experimental unit and data were analyzed using a mixed-effects model for repeated measures. Feed intake was lower (P < 0.01) in HFL (22.8 ± 0.54 kg/d) than in CTR (24.9 ± 0.54 kg/d) or EXT (25.7 ± 0.54 kg/d) cows, and it was affected by an interaction (P < 0.01) between treatment and time due to a lower increase in DMI in HFL as the study progressed. Milk yield and milk protein content did not differ among treatments. Milk fat content (P > 0.02) was lower in EXT (3.33 ± 0.06%) compared with CTR (3.55 ± 0.06%) cows, with HFL cows (3.36 ± 0.06%) not differing with either treatment. Milk fat yield (P < 0.01) and ECM (P = 0.02) were affected.
by an interaction between treatment, week and parity with multiparous cows on CTR producing more fat and ECM at the beginning of the study and multiparous cows on HFL producing more fat and ECM toward the end. As a result, feed efficiency (ECM/DMI) was greatest (P < 0.01) in HFL (1.83 ± 0.04), with no differences between CTR (1.63 ± 0.04) and EXT (1.66 ± 0.04) cows. Although HFL cows had a lower DMI, yield performance and BW were not affected along the study. We conclude that HFL has the potential to improve FE through a decrease in DMI while sustaining milking performance.

**Key Words:** linseed, linolenic acid, palm fatty acid distillates

**W119** Impact of feed intake and fiber digestibility on milk fatty acid profile and yield. J. de Souza*1,2 and A. L. Lock1, 1Michigan State University, East Lansing, MI, 2Perdue AgriBusiness, Salisbury, MD.

We determined the impact of feed intake (DMI) and total-tract fiber digestibility (NDFd) on milk fatty acid (FA) profile and yield responses in dairy cows. Our analysis used individual observations (n = 808) from 169 Holstein cows from 11 studies. Diets (% DM) contained (mean ± SD) 30.1 ± 1.94 NDF, 26.9 ± 2.09 starch, and 4.12 ± 0.78 total FA. DMI averaged 27.2 kg/d (range 14 to 39 kg/d) and NDFd averaged 40.4% (range 28 to 58%). Milk FA were classified as: <16C (summation of FA lower than 16-carbon, de novo FA), 16C (summation of 16-carbon FA, mixed FA), >16C (summation of FA greater than 16-carbon, preformed FA), and are reported in g/100 g FA, g/100 g milk, and g/d. Mixed model regressions were developed taking into account experiment, period within experiment, and cow within experiment as random factors. Model regressions were developed taking into account experiment, FA), and are reported in g/100 g FA, g/100 g milk, and g/d. Mixed model regressions were developed taking into account experiment, period within experiment, and cow within experiment as random factors. Increasing DMI linearly increased <16C milk FA as g/100 g FA [17.6 ± 0.02 ± 0.002 × DMI, P < 0.001], >16C milk FA as g/d [489 ± 39.0 + 1.39 ± 0.72 × NDFd, P < 0.001], and g/d [157 ± 5.89 + 7.57 ± 0.95 × NDFd, P < 0.001]; however, NDFd was not associated with >16C milk FA as g/100 g milk (P = 0.37). Increasing C16:0 intake linearly increased C16:0 milk FA [76.1 ± 0.63 vs. 76.9 ± 0.77, P < 0.01] supplemented diets decreased FAd. Milk FA were determined by gas-liquid chromatography. Mixed model regressions were developed taking into account experiment, period within experiment, and cow within experiment as random factors. Overall, no relationship was observed between the intake of C16:0 and yield of milk FA (g/d). Overall, no relationship was observed between the intake of C16:0 and yield of milk FA (g/d). Overall, no relationship was observed between the intake of C16:0 and yield of milk FA (g/d). Overall, no relationship was observed between the intake of C16:0 and yield of milk FA (g/d).

**Key Words:** digestibility, meta-analysis, palmitic acid

**W120** Degree of esterification and fatty acid profile of C16:0-enriched supplements impact fatty acid digestibility in lactating dairy cows: A meta-analysis. J. de Souza*1,2, N. R. St-Pierre2, and A. L. Lock1, 1Michigan State University, East Lansing, MI, 2Perdue AgriBusiness, Salisbury, MD.

We determined apparent total-tract fatty acid (FA) digestibility of lactating dairy cows fed palmitic acid (C16:0)-enriched supplements differing in their degree of esterification and FA profile. Our analysis utilized individual observations (n = 385) of mid-lactation Holstein dairy cows from 7 Latin square design studies. Diets (% DM) contained (mean ± SD) 30.6 ± 3.66 NDF, 27.1 ± 2.16 starch, and 4.0 ± 0.97 total FA. C16:0 supplements were classified based on the degree of esterification and FA profile as follows: a) C16:0_FFA (prilled free FA supplements containing ~85% C16:0 and ~60% C18:1); b) C16:0_TAG (prilled triglyceride supplements containing ~80% C16:0 and ~13% C18:1); and c) C16:0_blend (blend of free FA and Ca-salt supplements containing ~80% C16:0 and ~10% C18:1). Data were analyzed using a mixed model including treatment as a fixed effect and study, cow (study), and period (study) as random effects. To estimate supplement FA digestibility, we used a Lucas test with a regression of the intake of supplemental FA (g/d) on supplemental absorbed FA (g/d); slopes indicate true digestibility and intercepts endogenous synthesis. Apparent total-tract FA digestibility (FAd, %) for control diets (no supplemental fat) was 76.1 ± 0.63 (mean ± SEM) and was not different across studies (P > 0.85). We did not observe differences in FAd between control and C16:0_blend supplemented diets (76.1 ± 0.63 vs. 76.3 ± 0.89, P = 0.92). In contrast, compared with control, C16:0_FFA (76.1 ± 0.63 vs. 71.9 ± 0.66, P < 0.01) and C16:0_TAG (76.1 ± 0.63 vs. 69.8 ± 0.77, P < 0.01) supplemented diets decreased FAd. Increasing NDFd linearly increased FAd compared with C16:0_FFA (P < 0.01) and C16:0_TAG (P < 0.01) supplemented diets. Additionally, C16:0_FFA supplemented diets increased FAd compared with C16:0_TAG (P < 0.05) supplemented diets. Digestibility for supplemental fats estimated by Lucas test were 69.2 ± 2.62, 66.6 ± 1.47, and 76.4 ± 1.15 for C16:0_FFA, C16:0_TAG, and C16:0_blend, respectively. Our results demonstrate that the degree of esterification and FA profile of C16:0-enriched supplements impact total FA digestibility.

**Key Words:** digestibility, meta-analysis, palmitic acid
decreased the yield of milk C12:0 [52.1 ± 0.16 – 0.008 ± 0.0004 × 16:0 intake, \( P < 0.001, R^2 = 0.24 \)], and C14:0 [166 ± 0.40 – 0.008 ± 0.00009 × 16:0 intake, \( P < 0.001, R^2 = 0.25 \)]. Among individual preformed milk FA, increasing C16:0 intake linearly increased the yield of milk cis-9
C18:1 [272 ± 1.38 ± 0.04 ± 0.003 × 16:0 intake, \( P < 0.001, R^2 = 0.18 \)] and tended to decrease the yield of milk C18:0 [145 ± 10.8 - 0.009 ± 0.0005 × 16:0 intake, \( P = 0.06, R^2 = 0.10 \)]. Our results demonstrate that increasing dietary intake of C16:0 improves milk fat yield due to an increase in the yield of 16-carbon milk FA. Although C16:0 intake does not affect the yield of total de novo FA or preformed FA, specific changes in the yield of some individual de novo and preformed milk FA occurs, which is likely associated with mammary gland plasticity to maintain milk fluidity.

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

**W122**  
Milk fatty acids profile, blood serum, and oocyte quality of early-lactation dairy cows supplemented with linseed oil coated with vegetable fat or extruded linseed. J. Ruiz Rodriguez1, M. Puy-true digestibility of nutrients, and flows (g/d) of total N, NH
ammonia N (NAN), bacterial N, dietary N, RDP-N supply and bacterial
microbial fermentation impacts VFA synthesis and N utilization, respectively. Animal was the experimental unit and milk FA profile and serum results were analyzed using a mixed-effects model for repeated measures. Oocyte quality was analyzed using a mixed-effects model for repeated measures. Oocyte quality was evaluated morphologically. Animal was the experimental unit and milk FA profile and serum results were analyzed using a mixed-effects model for repeated measures. Oocyte quality was evaluated morphologically.

The aim of the study was to evaluate the effects of supplementing extruded linseed or linseed oil coated with hydrogenated palm fatty acids distillates (HPFAD) on milk fatty acid (FA) profile, oocyte quality and glucose, immunoglobulin IgG1 and NEFA blood serum of early-lactation dairy cows. Sixty-three Holstein cows (591 ± 84 kg BW, 42 ± 24.8 DIM, 37.2 ± 10.6 kg of milk/d) were randomly distributed in 3 groups (n = 21) and exposed for 84 d to 3 treatments following a complete randomized design. Treatments consisted of supplementation of 500 g/d of HPFAD (CTR), 350 g/d of extruded linseed and 390 g/d of HPFAD (EXT), or 500 g/d of HPFAD coated flaxseed oil (HFL). Both, HFL and EXT provided the same amount of C18:3. Cows were fed a TMR (15.5% CP, 33.7% NDF, 1.65Mcal of NEl/kg; DM basis) twice daily. Milk FA profile was determined at d 0, 5, 10, 28, 56 and 84. Blood glucose, NEFA, and IgG1 concentrations were determined at d 0, 28, 56 and 84. Oocyte pickup was performed at d 50 and oocyte quality was evaluated morphologically. Animal was the experimental unit and milk FA profile and serum results were analyzed using a mixed-effects model for repeated measures. Oocyte quality was analyzed using ordinal logistic regression. Results for FA are shown in Table 1. Serum glucose concentration was steady throughout the study in HFL cows, but it progressively decreased in CTR and EXT cows. Serum NEFA concentrations progressively decreased as lactation progressed. Serum IgG1 concentration in EXT cows was low except for an increase at d 84, whereas it remained steady in CTR and HFL cows. The odds of having second quality category oocytes was greater (1.62 more chances) in HFL and EXT compared with CTR. We conclude that HFL and EXT improve milk FA profile and show potential to improve oocyte quality in early-lactation cows.

**Table 1 (Abstr. W122).** Milk FA composition per treatment

<table>
<thead>
<tr>
<th>Fatty acid, %</th>
<th>CTR</th>
<th>EXT</th>
<th>HFL</th>
<th>SE</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C18:3</td>
<td>0.48±</td>
<td>0.64b</td>
<td>0.67b</td>
<td>0.05</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>C20:5</td>
<td>0.059b</td>
<td>0.070b</td>
<td>0.069a</td>
<td>0.001</td>
<td>0.01</td>
</tr>
<tr>
<td>Total unsaturated</td>
<td>3.96b</td>
<td>4.35a</td>
<td>4.25a</td>
<td>0.07</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Total n-3</td>
<td>0.60b</td>
<td>0.80a</td>
<td>0.83a</td>
<td>0.01</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

**Key words:** linseed, linolenic acid, palm fatty acid distillates (PFAD)

**W123**  
Lipid-coat protection of sodium selenite and copper sulfate from microbial fermentation impacts VFA synthesis and nitrogen metabolism in a dual-flow continuous culture system. J. A. Arce-Cordero1*, H. F. Monteiro1, A. L. Le lis1, R. Restelatto2, L. R. Lima3, V. L. N. Brandao3, L. G. Silva3, H. Leclerc4, and A. P. Faciolou1, 1Department of Animal Sciences, University of Florida, Gainesville, FL, 2Department of Animal Sciences, Federal University of Parana, Curitiba, PR, Brazil, 3Department of Animal Sciences, Federal University of Mato Grosso, Cuiaba, MT, Brazil, 4Jefo, St. Hyacinthe, QC, Canada.

Antimicrobial effects of CuSO4 and Na2SeO3 have been reported in the literature. As common sources of Cu and Se for ruminants, we aimed to evaluate the effects of lipid-coat protection of CuSO4 and Na2SeO3 on microbial fermentation in a dual-flow continuous culture system. We used 8 fermenters in a 4 × 4 duplicated Latin-square design with a 2 × 2 factorial arrangement of treatments (2 mineral sources × 2 protection levels). Treatments were: 1) unprotected Cu and Se, 2) protected Cu + unprotected Se, 3) protected Se + unprotected Cu, 4) protected Cu and Se. Main effects of protection of Cu, Se, and their interaction were tested. Fermenters were fed 106 g DM/d and all diets had the same nutrient composition (16% CP, 31% NDF, 29.5% starch, 1.6 MCal ENl/kg, 18 ppm Cu, and 0.4 ppm Se). Experimental period length was 10 d (7 d of adaptation and 3 d for sample collections). Daily pooled samples of effluents were analyzed for VFA, NH3-N, soluble Cu and Se, ruminal true digestibility of nutrients, and flows (g/d) of total N, NH3-N, non-ammonia N (NAN), bacterial N, dietary N, RDP-N supply and bacterial efficiency. Kinetics of pH, VFA, and NH3-N was evaluated as repeated measures in samples collected daily at 0, 1, 2, 4, 6, and 8 h post morning feeding. Protection of Cu, Se, or their interaction did not affect pH and NH3-N kinetics. Protection of Se tended to reduce: NH3-N effluent concentration (\( P = 0.09 \)), NH3-N flow (\( P = 0.07 \)), and RDP-supply (\( P = 0.06 \);) and tended to increase flows of: NAN (\( P = 0.06 \)) and dietary N (\( P = 0.06 \)). For VFA kinetics, protection of Cu reduced acetate % (\( P = 0.02 \)), increased butyrate % (\( P = 0.04 \)), and tended to decrease acetate:propionate (\( P = 0.06 \)). Protecting both Cu and Se reduced isovalerate % (\( P = 0.05 \)) and tended to reduce BCVFA % (\( P = 0.07 \)). Our results suggest that lipid-coat protection of CuSO4 and Na2SeO3 might benefit ruminal fermentation through increased efficiency of VFA synthesis and N utilization, respectively.

**Key Words:** minerals, ruminal fermentation, selenium
W124  Bioequivalence test of neutral detergent fiber analysis with or without an acetone wash of feed ingredients, orfs, and feces from cows fed fat-supplemented diets. J. M. dos Santos Neto*1,2, J. de Souza1,3, C. M. Prom1, and A. L. Lock1, 1Michigan State University, East Lansing, MI, 2University of São Paulo, Piracicaba, São Paulo, Brazil, 3Perdue AgriBusiness, Salisbury, MD.

We evaluated whether neutral detergent fiber (NDF) and indigestible NDF (iNDF) determination without an acetone wash step of feed, orfs, and feces from cows fed fat-supplemented diets is equivalent to the original method using acetone. Thirty-two samples of feeds, orfs, and feces were obtained from a 4 × 4 Latin square design study with 8 cows that determined effects of fatty acid (FA) supplements with different ratios of stearic (SA) and oleic (OA) acids on nutrient digestibility. Treatments were a non-FA supplemented control diet (CON) and 3 diets incorporating FA supplements (1.5% DM) containing 50% SA + 10% OA, 40% SA + 20% OA, and 30% SA + 30% OA. Analysis of NDF proceeded with heat-stable α-amylase, sodium sulfite, filtering process on glass crucible, and washing step (WS) with water and acetone (AC) or with water only (WA). Ash content was excluded from the NDF. A 240-h in vitro fermentation was used to determine iNDF. Bioequivalence testing with a 90% confidence interval (CI) was used to verify if NDF determination using WA is equivalent to AC. For this, it was determined if the lower (L) and upper (U) limit of the mean difference (MD) falls into an equivalence interval −2 < L < +2. Statistical analysis was performed using PROC MIXED of SAS, including fixed effects of diet, WS, their interactions, and random effects of cow and period. Overall, dietary NDF content determined from AC and WA analysis of feeds was 32.4% and 32.3% (SEM = 0.03), respectively. NDF content in control (33.3%; SEM ± 0.04) or FA treatments (32.1%; SEM ± 0.03) was not affected by WS. NDF intake did not differ between AC and WA (10.0 vs. 9.98 kg/d; P = 0.84). Interactions between WS and FA treatments were tested for NDF and iNDF in orfs and feces; all interactions were bioequivalent. Independent of treatment, WA was equivalent to AC for NDF content of orfs (MD = 0.46; L = −0.26; U = 1.18) and feces (MD = 0.97; L = 0.46; U = 1.48), and for iNDF content of orfs (MD = 0.36; L = −0.14; U = 0.87) and feces (MD = 0.60; L = −0.43; U = 1.64). In conclusion, NDF analysis with or without acetone wash was equivalent for determination of NDF intake and the content of NDF and iNDF of orfs and feces of dairy cows fed FA supplemented diets.

Key Words: lipolysis, oleic acid

W125  Oleic acid supplementation alters adipose tissue lipolytic responses and insulin sensitivity in early-lactation dairy cows. J. Laguna1,2, M. Gonzalez2, C. Prom2, A. Lock2, and A. Contreras3, 1Department of Large Animal Clinical Sciences, Michigan State University, East Lansing, MI, 2Department of Animal Science, Michigan State University, East Lansing, MI.

We previously reported that postpartum supplementation of oleic acid (cis-9 C18:1; OA) increased milk yield and reduced plasma NEFA and body weight loss; however, the mechanisms driving these responses are unknown. In rodent adipose tissue (AT), OA enhances lipogenesis and potentiates the effects of insulin; however, responses to OA supplementation in bovine AT have not been characterized. Our objective was to determine the effects of postpartum OA supplementation on AT responses to isoproterenol and insulin. Multiparous cows were infused abomasally with 60 g/d of OA (n = 6) or vehicle (VEH, n = 6) from 1 to 15 d postpartum. Subcutaneous AT (SCAT) explants were collected at −14, −6, and +12 d relative to parturition and incubated for 3 h at 37°C with 0 µM (CON) or 1 µM of β adrenergic agonist isoproterenol (ISO) to induce lipolysis. The anti-lipolytic effect of insulin at low (0.2 µL/L, INL) and high concentration (1 µL/L, INH) was determined during ISO stimulation. Lipolytic responses were evaluated by quantification of glycerol release. ISO responses are reported as % increase over CON. Insulin responses are reported as % decrease over ISO. Statistical analysis was performed using a mixed linear model, considering as fixed effects OA infusion, time, treatments and their interaction. Across treatments and sample time points, ISO increased the lipolytic responses by 300 ± 25% compared with CON (P < 0.001). Lipolytic response to ISO was not different between VEH and OA groups before infusions (−14 d). Compared with CON, OA infusion reduced lipolytic response to ISO at +6 d (VEH = 177 ± 6.5% and OA = 167 ± 6.5%; P = 0.06) and at +12 d (VEH = 258 ± 7.8% and OA = 157 ± 7.8%; P = 0.02). Compared with ISO, INL and INH inhibited lipolysis by −170 ± 2.5% and −231 ± 2.5%, respectively (P < 0.001). The anti-lipolytic effect of INL and INH did not differ between VEH or OA groups before infusions (−14 d). At +6 and +12 d. INH had a stronger anti-lipolytic response in OA (−222 ± 5.5% and −238 ± 7.2%) compared with VEH (−106 ± 5.5% and −128 ± 7.2%; P < 0.05), respectively. Results demonstrate that oleic acid supplementation immediately postpartum reduces lipolytic responses and improves insulin sensitivity of AT in early lactation dairy cows.

Key Words: acetone, bioequivalence, NDF

W126  Impact of feeding a palmitic enriched supplement on production responses of mid-lactating Jersey and Holstein cows. A. Sears*, A. Alberto, O. Gonzalez, A. Young, and F. Batistel, Department of Animal, Dairy, and Veterinary Sciences, Utah State University, Logan, UT.

A study was conducted to evaluate the effects of feeding a palmitic enriched supplement on production responses of mid-lactating Jersey and Holstein cows. Eighty cows (40 Holstein and 40 Jersey) were used in a randomized complete block design with a split-plot arrangement, where the main plot was breed and subplot treatment. Cows within each breed were assigned to 1 of 2 treatments: 1) control diet without fat supplement, or 2) control diet plus a palmitic acid enriched supplement fed at 1.5% of diet dry matter. Cows were milked in 2 robotic milking units and treatments were offered through the robots. The diets contained 18.0% forage NDF, 29% NDF, 22.4% starch and 17.3% CP. Treatment period was 6 weeks with the final 3 weeks used for data and sample collection. The statistical model included the random effect of block and cow nested within breed, and the fixed effect of treatment, breed, time and their interactions. Preliminary milk yield was used as a covariate. Differences were declared at P ≤ 0.05 and tendencies at P ≤ 0.10. Compared with control, palmitic acid increased milk fat yield (1.36 vs. 1.27 kg/d; SEM = 0.06; P = 0.03), and tended to increase FCM (35.6 vs. 33.8 kg/d; SEM = 1.86, P = 0.09) as well as ECM (35.8 vs. 34.2 kg/d; SEM = 1.82, P = 0.10). There were no effects of palmitic acid on milk yield (P = 0.68), milk protein yield (P = 0.22), milk lactose yield (P = 0.74), BCS (P = 0.76) or BW change (P = 0.91). Compared with Holstein cows, Jersey cows had lower milk production (29.6 vs. 32.7 kg/d; SEM = 1.01, P = 0.03); Holstein cows gained 0.145 kg/d. There were no effects of breed on milk protein yield (P = 0.22), milk lactose yield (P = 0.2), milk fat yield (P = 0.10) compared with control, palmitic acid increased milk fat yield by 300 ± 25% compared with CON (P = 0.03). There were no effects of breed on milk protein yield (P = 0.85), FCM (P = 0.97), ECM (P = 0.99), and BCS (P = 0.59). No interaction treatment × breed was detected for the variables analyzed. Overall, feeding palmitic acid enriched supplement increased milk fat...
We evaluated the effects of commercially available saturated fatty acid (SFA) supplements on nutrient digestibility and production responses of lactating dairy cows. The database was formed from 30 peer-reviewed publications in which SFA supplements were fed at ≤3% diet DM. Supplements were classified as mixed SFA (MIX: ≥80% C16:0+C18:0) or palmitic acid-enriched (PALM: ≥80% C16:0) supplements and compared with nonfat supplemented diets used as control. Meta-analysis was performed using PROC MIXED of SAS, including fixed effects of fat source, and random effects of study, and its interaction with treatment. Studies were weighted based on the inverse of the sum of both the within and among study variance. There was no interaction between treatments and experimental design (randomized vs. crossover/Latin square; \( P > 0.93 \)). Overall, SFA supplementation did not affect DMI (\( P = 0.68 \)), increased milk (1.36 kg/d, \( P < 0.01 \)) and fat (0.07 kg/d, \( P < 0.01 \)) yields, tended to increase protein yield (0.03 kg/d, \( P = 0.06 \)), increased milk fat content (0.12%, \( P = 0.01 \)), decreased milk protein content (0.04%, \( P = 0.03 \)), tended to increase DM digestibility (1.19%, \( P = 0.07 \)), increased NDF digestibility (3.19%, \( P < 0.01 \)), and did not affect FA digestibility (\( P = 0.29 \)). Compared with control, MIX did not affect DMI (\( P = 0.64 \)), increased milk (1.19 kg/d, \( P < 0.01 \)) and fat (0.05 kg/d, \( P = 0.05 \)) yields, did not affect protein yield (\( P = 0.34 \)) or fat content (\( P = 0.34 \)), tended to decrease protein content (0.06%, \( P = 0.06 \)), and had no effect on nutrient digestibility (all \( P > 0.30 \)). Compared with control, PALM did not affect DMI (\( P = 0.19 \)), increased milk (1.54 kg/d, \( P = 0.04 \)) and fat (0.10 kg/d, \( P < 0.01 \)) yields, tended to increase protein yield (0.04 kg/d, \( P = 0.09 \)), increased fat content (0.17%, \( P < 0.01 \)), and did not affect protein content (\( P = 0.22 \)), and increased DM and NDF digestibility by 1.56% (\( P = 0.02 \)) and 4.79% (\( P < 0.01 \)) units, respectively. PALM had no effect on FA digestibility (\( P = 0.53 \)). Overall, SFA supplementation increased yields of milk and milk fat without affecting DMI, with differences for each SFA supplement type. PALM increased DM and NDF digestibility but MIX did not impact nutrient digestibility.

**Key Words:** digestibility, fat supplementation, meta-analysis

W127  **Heat treatment from pelleting or extrusion did not impact performance of *Saccharomyces cerevisiae* fermentation products on volatile fatty acid production in an in vitro rumen model.** C. Reedy*, I. Yoon, J. Butler, and T. Werner, Diamond V, Cedar Rapids, IA.

The objective of this study was to evaluate the effect of *Saccharomyces cerevisiae* fermentation products, Diamond V Original XPC (XPC), XPC Ultra (XPC Ultra), and NutriTek (NutriTek) on in vitro volatile fatty acid (VFA) production before and after going through either pelleting or extrusion. XPC Ultra was pelleted at 80°C for 60 s. XPC and NutriTek were extruded at 135°C for 30 s and dried at 145°C for 30 min. Test products were added to each serum bottle relative to their recommended feeding rates - XPC (14 g/d), XPC Ultra (7 g/d), and NutriTek (19 g/d) - along with 0.3 g of cellulose as substrate. Each serum bottle was inoculated with 40 mL of buffered rumen fluid from cows on a diet consisting of 70% forage and 30% concentrate and was incubated for 24 h. Ten replicates were run per treatment. Data was analyzed using the GLM model of JMP. Means were compared using Tukey test and significance was defined as \( P = 0.05 \). After incubation, VFA production was measured and reported in Table 1. Results showed that both heat-treated and untreated products significantly increased ruminal VFA production over Control while showing no difference between heat-treated and untreated products. In conclusion, heat-treatment had little effect on the performance of the products tested in an in vitro rumen model, which suggests that *Saccharomyces cerevisiae* fermentation products could go through pelleting or extrusion and fully express their potentials in processed feeds requiring heat treatment.

**Key Words:** body weight, fat supplementation, milk fat

W128  **Nutrient digestibility and production responses of lactating dairy cows when commercially available saturated fatty acid supplements are included in diets: A meta-analysis.** J. M. dos Santos Neto*1,2, J. de Souza1, and A. L. Lock1, 1Michigan State University, East Lansing, MI, 2University of São Paulo, Piracicaba, São Paulo, Brazil.

We evaluated the effects of commercially available saturated fatty acid (SFA) supplements on nutrient digestibility and production responses of lactating dairy cows. The database was formed from 30 peer-reviewed publications in which SFA supplements were fed at ≤3% diet DM. Supplements were classified as mixed SFA (MIX: ≥80% C16:0+C18:0) or palmitic acid-enriched (PALM: ≥80% C16:0) supplements and compared with nonfat supplemented diets used as control. Meta-analysis was performed using PROC MIXED of SAS, including fixed effects of fat source, and random effects of study, and its interaction with treatment. Studies were weighted based on the inverse of the sum of both the within and among study variance. There was no interaction between treatments and experimental design (randomized vs. crossover/Latin square; \( P > 0.93 \)). Overall, SFA supplementation did not affect DMI (\( P = 0.68 \)), increased milk (1.36 kg/d, \( P < 0.01 \)) and fat (0.07 kg/d, \( P < 0.01 \)) yields, tended to increase protein yield (0.03 kg/d, \( P = 0.06 \)), increased milk fat content (0.12%, \( P = 0.01 \)), decreased milk protein content (0.04%, \( P = 0.03 \)), tended to increase DM digestibility (1.19%, \( P = 0.07 \)), increased NDF digestibility (3.19%, \( P < 0.01 \)), and did not affect FA digestibility (\( P = 0.29 \)). Compared with control, MIX did not affect DMI (\( P = 0.64 \)), increased milk (1.19 kg/d, \( P < 0.01 \)) and fat (0.05 kg/d, \( P = 0.05 \)) yields, did not affect protein yield (\( P = 0.34 \)) or fat content (\( P = 0.34 \)), tended to decrease protein content (0.06%, \( P = 0.06 \)), and had no effect on nutrient digestibility (all \( P > 0.30 \)). Compared with control, PALM did not affect DMI (\( P = 0.19 \)), increased milk (1.54 kg/d, \( P = 0.04 \)) and fat (0.10 kg/d, \( P < 0.01 \)) yields, tended to increase protein yield (0.04 kg/d, \( P = 0.09 \)), increased fat content (0.17%, \( P < 0.01 \)), and did not affect protein content (\( P = 0.22 \)), and increased DM and NDF digestibility by 1.56% (\( P = 0.02 \)) and 4.79% (\( P < 0.01 \)) units, respectively. PALM had no effect on FA digestibility (\( P = 0.53 \)). Overall, SFA supplementation increased yields of milk and milk fat without affecting DMI, with differences for each SFA supplement type. PALM increased DM and NDF digestibility but MIX did not impact nutrient digestibility.

**Key Words:** Diamond V Original XPC, pelleting, extrusion

W129  **The effect of saturated fatty acid supplements in dairy cow diets on odd- and branched-chain fatty acids in milk fat: A meta-analysis and meta-regression.** J. M. dos Santos Neto*1,2, J. de Souza1, and A. L. Lock1, 1Michigan State University, East Lansing, MI, 2University of São Paulo, Piracicaba, São Paulo, Brazil.

There are few studies reporting the effects of saturated fatty acid (FA) supplementation on odd- and branched-chain fatty acids (OBCFA)
in milk fat or the relationship of nutrient intake and digestibility on OBCFA in milk fat. We used a meta-analysis to evaluate the effects of dietary inclusion of mixed FA (MIX: ~34% C16:0 and ~50% C18:0) or palmitic acid-enriched (PALM: ≥80% C16:0) supplements on OBCFA in milk fat of dairy cows. The meta-regression was used to evaluate the relationships of DMI and NDF digestibility (NDFd) with yields of OBCFA in milk fat. OBCFA were grouped as follows: odd linear FA (C13:0 + C15:0 + C17:0); iso FA (iso C13:0 + iso C14:0 + iso C15:0), and anteiso FA (anteiso C13:0 + anteiso C15:0). The data set was assembled with individual cow data from 3 studies at Michigan State University, including individual observations of 88 Holstein cows (74 multiparous and 14 primiparous). PALM (n = 107) and MIX (n = 47) were compared with non-FA supplemented diets as control (n = 105). Statistical analyses were performed using the PROC MIXED of SAS, including study as random effect. PALM reduced the yield of odd linear, iso, and anteiso FA by 1.58 (P = 0.05), 0.27 (P = 0.05) and 0.50 g/d (P < 0.01) respectively; a total decrease in OBCFA of 2.26 g/d (P = 0.03). MIX did not affect odd linear FA (P = 0.41), decreased iso FA (0.36 g/d; P = 0.04), tended to decrease anteiso FA (0.41 g/d; P = 0.07), and had no effect on total OBCFA (P = 0.71). We observed a similar pattern of results for OBCFA content compared with yield of OBCFA in milk fat. There was a positive linear relationship between DMI (kg/d) and the yield of total OBCFA (R2 = 0.19, P < 0.01). There was a tendency for a quadratic relationship between NDFd and yield of iso FA (R2 = 0.04, P = 0.07), with the highest value for iso FA yield obtained at 44.8% NDFd. There was no relationship among the other OBCFA groups and NDFd. In conclusion, PALM supplementation decreased the content and yield of all OBCFA groups. MIX supplementation only decreased the yield of iso FA and the content of anteiso FA. DMI increased OBCFA yield.

**Key Words:** fat supplementation, meta-analysis, odd- and branched-chain fatty acid

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**W310  Effect of betaine supplementation on total serum fatty acids profile in mid-lactating Holstein dairy cows.** H. C. Hung*1, C. Y. Tsai1, M. Chahine1,2, and P. Rezamand1, 1Department of Animal and Veterinary Science, University of Idaho, Moscow, ID, 2Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID.

Betaine is a product of choline oxidation in the body and an ingredient of wheat and sugar beets. Betaine can donate one methyl group to transfer homocysteine into methionine, which is involved in the phosphatidyl-ethanolamine N-methyltransferase (PEMT) pathway. We hypothesized that betaine supplementation affects the serum fatty acids (FA) profile in mid-lactation dairy cows. There were 21 mid-lactation dairy cows assigned to a 3 × 3 Latin square design with 3 periods of 28 d each and 3 treatments of betaine (0, 100, and 200 g/d). Milk samples collected on d 21 and d 28 and blood samples obtained on d 26 to 28 of each period were used for FA analysis via gas chromatography with flame ionization detector and an Agilent HP-88 column (100 m × 0.25 mm with 0.2-µm film thickness, Agilent Technologies). Individual FA was identified by comparison to the standard mixture Supelco 37 FAME (Supelco, Bellefonte, PA). Data were analyzed using the PROC Mixed of SAS with significance declared at P ≤ 0.05 and trends at P ≤ 0.1. Results showed that no change was observed in the content of total serum saturated FA (40.5, 40.4, and 40.3 ± 0.6% for 0, 100, and 200 g betaine, respectively; P = 0.96). The total serum monounsaturated FA decreased with betaine supplementation (16.2, 15.2, and 14.9 ± 0.32%, for 0, 100, and 200 g betaine, respectively; P = 0.01). Serum FA profile showed a decline in the n-6 to n-3 ratio (6.80, 7.07, and 6.50 ± 0.16%, for 0, 100, and 200 g betaine, respectively; P = 0.04). Results showed however that milk FA profile did not differ among treatments (0, 100, and 200g betaine/d per cow, respectively). Overall, our study demonstrated that betaine supplementation affected the total serum FA profile in mid-lactation dairy cows without affecting the milk FA profile.

**Key Words:** lactating dairy cow, dietary betaine, serum fatty acid

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**W312 Assessing recovery of 13C-enriched branched-chain VFA and branched-chain AA into rumen bacterial fatty acids.** Y. Roman-García1, B. L. Denton1, K. E. Mitchell1, L. K. Lee1,2, M. Socha3, and J. L. Firkins1, 1The Ohio State University Department of Animal Science, Columbus, OH, 2Ohio Agricultural Research and Development Center, Wooster, OH, 3Zinpro Corporation, Eden Prairie, MN.

To test if incorporation profile of branched-chain VFA (BCVFA) or AA (BCAA) influenced elongation into bacterial FA, we dosed 13C-labeled BCVFA and BCAA into batch cultures of mixed rumen microbes. Treatments were 1) Control, 2) 13C-enriched isovalerate, isobutyrate, 2-methylbutyrate, and valerate (1 mM final concentration each), 3) 13C-enriched Ile, Leu, and Val (1 mM final concentration each), or 4)
a 50:50 mix of BCVFA and BCAA (MIX). In 2 replicate tubes, 30 mL of a 1:4 dilution of blended rumen fluid in artificial saliva buffer was added anaerobically to 50-mL tubes with either 0.25 g of corn + 0.25 g of alfalfa hay (AHC) or 0.25 g of corn + 0.25 g of orchardgrass hay (OHC). Total FA in bacteria harvested at 24 h of incubation was not affected by treatment or treatment x feed interaction (P > 0.55). Adding BCVFA or BCAA increased (P < 0.05) 13:0, iso 14:0, and total odd chain FA (OCFA; g/100 g total FA). Total dose recovered in FA was not affected (P > 0.15) by BCAA (0.169%), MIX (0.193%), or BCVFA (0.206%). Linear (L) and quadratic (Q) contrasts were evaluated with PROC MIXED in SAS (2 runs as random effect) for 1) BCAA, 2) MIX, and 3) BCVFA. For dose recovery in 13:0, iso 16:0, 17:0, and iso 17:0, there was a L increase (P < 0.05) in enrichment for BCVFA substitution over BCAA (P < 0.15). There was a treatment x feed interaction (P < 0.02) for anteiso 14:0, 15:0, anteiso 17:0, and OCFA enrichment. With AHC, anteiso 14:0 increased enrichment linearly (P < 0.03) at a decreasing rate (P = 0.12 for Q) with BCVFA substituting for BCAA. For 15:0 and total OCFA, L and Q were both P < 0.01, with enrichment increasing linearly at a decreasing rate with BCVFA substituting for BCAA. With OHC, 15:0, anteiso 17:0, and total OCFA enrichment increased linearly (P < 0.03; P > 0.15 for Q) as BCVFA replaced BCAA. Enrichment of anteiso 14:0 was highest with MIX (P > 0.15 for L; P < 0.01 for Q). The bacterial FA profile was similar among treatments, but the enrichment of the OCFA and several BCFA was greatly increased by dosing BCVFA over dosing BCAA, or a MIX, supporting a potential benefit from higher concentration of elongation primers regardless of substrate.

Key Words: branched-chain VFA, branched-chain AA

**W134** Screening unsaturated fat sources included to low- and high-forage diets with different fat dietary concentration using an in vitro gas production system. S. M. Hussein*, M. X. Toledo, S. Twyman, O. Thomas, J. Echesabal, and G. J. Lascano, Department of Animal and Veterinary Sciences, Clemson University, Clemson, SC.

Fat inclusion can increase energy density of diets fed to ruminants, but detrimental effects to nutrient digestion have been reported. There is evidence that not all fat sources have this negative response and this effect can vary depending on the forage concentration in the diet. The objective of this experiment was to determine the effects of including different types of unsaturated fats to low and high forage diets in vitro digestibility and fermentation. An experiment was conducted using an in vitro gas production (GP) system. Treatments included either low forage (LF; 35%) or high forage (HF; 70%) with 2 dietary fat concentrations (6 or 9%) and of 7 different fat source treatments (control + 6 different types of unsaturated fat sources). The control diet had a basal level of fat in the diet [3% fat (0% fat inclusion); and fat sources were added to attain 6% or 9% fat and consisted of (Coconut oil, CO; Poultry fat, PF; Palm oil, PO; Palm kernel oil, PKO; Ca Salts, MEG; Soybean oil, SOY)]. Modules (GP) were randomly assigned to treatments in a 2 × 2 × 7 factorial design and incubated for 2 24 h runs. A randomized complete block design with 4 replicates per treatment and 2 runs was used. Run was the blocking factor. Data were analyzed using the MIXED procedure of SAS. Apparent digestibility (AD) for DM, OM, NDF, ADF and true dry matter digestibility (TDMD) were higher in LF-treatment. Cumulative gas produced in mL was greater in LF (P = 0.01). Fat concentration had no effect on AD, but the 6% fat had a higher gas production (P = 0.03; 109.6 vs. 103.5 mL ± 2.44). The CO had the highest DM AD followed by SOY and PF (54.5, 51.8, and 50.6 ± 0.48) and cumulative gas production followed same pattern. The TDMD and OM AD were higher in CO; however, the NDF and ADF AD were higher in MEG-fed modules. Final pH was not affected by treatments. Final NH₃-N concentration was greater in HF and 9% fat. These results suggest that LF diets with high dietary fat concentration can be utilized and different types of fat sources may improve DM and fiber rumen digestibility.

Key Words: gas production system, coconut oil, poultry fat