
The objective of this experiment was to determine effects of 2-hydroxy-(4-methylthio) butanoic acid (HMTBa), isoacids on rumen fermentation, production, and milk fatty acid during mild milk fat depression in lactating cows. E. Copelin, J. Firkins, M. T. Socha, and C. Lee.

Production, Management, and the Environment


The meta-analysis examined the effects of mitigation strategies on enteric CH₄ emission (CH₄ E, g/d), Y₄ (CH₄ energy, % of gross energy intake), CH₄ yield [g/kg dry matter intake (DMI)], CH₄ emission intensity [EE, g/kg milk yield (MY) or average daily gain (ADG)], DMI (kg/d), ADG (kg/d), and neutral detergent fiber digestibility (NDFD, %) in ruminants. The database consisted of data reported in 437 published studies (1963 to 2018) using cattle (65% of the data) and small and other ruminants (35%). Mitigation strategies were classified into 3 main categories: animal and feed management, diet formulation, and rumen manipulation, and up to 5 subcategories (99 total mitigation strategy combinations, which are not discussed here). A random-effects meta-analysis weighted by inverse variance was carried out (Comprehensive Meta-Analysis, V3.3.070). Mitigation effects were based on the relative mean ratio (treatment over control) to standardize effects across studies. Significance was based on α = 0.05 with values adjusted for multiple comparisons. Daily CH₄ emissions were analyzed in 783 mean comparisons, followed by number of mean comparisons in descending order by DMI (706), CH₄ yield (598), ADG (376), Y₄ (354), CH₄ Ei (260), MY (245), and NDFD (206). Rumen manipulation decreased (P ≤ 0.05) CH₄ E (−11%), Y₄ (−10%), CH₄ yield (−12%), and CH₄ Ei (−12% for ADG) and increased (P ≤ 0.01) DMI (+1%). Diet formulation decreased (P ≤ 0.01) CH₄ E (−7%), Y₄ (−10%), CH₄ yield (−10%), and CH₄ Ei (−10% and −8% for ADG and MY, respectively) and increased (P ≤ 0.01) DMI (+2%) and MY (+7%) but it also decreased NDFD (−3%; P ≤ 0.01). Animal and feed management increased (+7%; P ≤ 0.01) CH₄ E, but it also increased (P ≤ 0.01) CH₄ Ei (+17%), ADG (+27%), MY (+11%), and NDFD (+6%) and thus decreased (P ≤ 0.01) Y₄ (−7%) and CH₄ Ei (−10% for MY). Specific practices within these main mitigation strategies effectively decreased CH₄ emission without compromising animal productivity. The practical implementation of mitigation strategies will depend on proven long-term effects, economic feasibility, government policies, and consumer acceptance.

Key Words: enteric methane, mitigation, meta-analysis

Effects of 2-hydroxy-(4-methylthio) butanoic acid (HMTBa), isoacids, milk fat depression

Effects of 2-hydroxy-(4-methylthio) butanoic acid and isoacids on rumen fermentation, production, and milk fatty acid during mild milk fat depression in lactating cows. J. E. Copelin, J. L. Firkins, M. T. Socha, and C. Lee.

The objective of this experiment was to determine effects of 2-hydroxy-(4-methylthio) butanoic acid (HMTBa), isoacids (isobutyrate, isovalerate, 2-methylbutyrate, valerate) or their combination on alleviation of milk fat depression (MFD). Ten Holstein cows (5 cannulated and 5 non-cannulated) were used in a repeated 5 x 5 Latin square design. Treatments included 1) high forage diet (HF; 33% NDF, 24.0% starch, and 3.5% PUFA on a DM basis), 2) low forage diet (LF; 29% NDF, 29% starch, and 3.5% PUFA), 3) LF with HMTBa at 0.1% (DM basis; LF-HMTBa), 4) LF with isoacids (60 g/d; equal amounts of all isoacids; LF-IA) and 5) LF supplemented with both HMTBa and IA. Data were analyzed using the Mixed procedure of SAS [random effect, square and cow(square); fixed effect, diet]. Preplanned contrasts were used to compare HF vs. LF and to examine the effect of HMTBa, IA, or their interaction compared with LF. Molar proportion of propionate increased (P < 0.01) and acetate decreased (P = 0.10) for LF vs. HF. Supplementation of HMTBa increased (P = 0.04) molar proportion of butyrate compared with LF. The addition of IA increased (P < 0.01) molar proportions of branched-chain VFA in the rumen. Milk fat content (3.20 vs. 3.46%; P = 0.04) and yield (0.86 vs. 0.98 kg/d; P < 0.01) decreased for LF vs. HF. The MFD with LF was alleviated by LF-HMTBa and LF-IA; HMTBa increased milk yield (P = 0.03) without altering milk fat content and LF-IA tended to increase (P = 0.08) milk fat content without altering MFD. However, an interaction for milk fat yield (P < 0.01) was observed between HMTBa and IA, suggesting no additive effect. Moreover, LF-IA decreased (P = 0.03) total preformed fatty acids and increased (P = 0.04) de novo synthesized fatty acids compared with LF treatment. In conclusion, during mild MFD, supplementation of HMTBa or IA alleviated the MFD. However, the alleviation of MFD appeared to be a result of different mechanisms, and no additive effects of the combination were observed on milk fat yield.

Key Words: milk microbiota, recycled bedding sand, dairy farm
406 Altering the ruminal microbiota in dairy calves using rumen contents dosing. M. Cox*1, P. Weimer1, A. Steinberger1, J. Skarlupka1, and G. Suen1. 1Department of Bacteriology, University of Wisconsin-Madison, Madison, WI, 2USDA Agricultural Research Service, Madison, WI.

A major goal in dairy research is to improve milk production efficiency (MPE). With the advent of next-generation sequencing and its use in characterizing microbial communities, efforts are underway to improve MPE by manipulating the rumen microbiota. MPE is correlated with ruminal bacterial community composition (BCC), but the adult rumen microbiota is highly stable and returns to a baseline BCC even after heavy perturbation. We seek to influence rumen BCC by early intervention in pre-weaning dairy calves. Two cannulated Holstein donors of disparate MPE were selected. Three cohorts of 6 bull calves were established and dosed by gavage with a rumen inoculum sourced from the high-efficiency donor (HE), the low-efficiency donor (LE), or an autoclaved 50:50 mix as a microbe-free control (C). Dosing occurred within 3 d of birth, then every 2 weeks through 6 weeks of age. Feces were collected at each dosing as a proxy for gut BCC. Daily dry matter intake of calf starter, which has been shown to predict downstream feed efficiency, was greatest in HE calves and lowest in C calves (P < 0.05), though preweaning average daily gain did not differ between cohorts (P = 0.210). Calves were sacrificed at 8 weeks to access rumen contents and rumen wall sections were collected to assess papillation. Fecal and rumen samples were subjected to 16S rRNA amplicon sequencing. We found that BCC differed by cohort in fecal and rumen samples (P < 0.05), with HE calf samples most similar to adult rumen samples and C calves least similar. Additionally, HE calves tended to have elongated papillae (P = 0.062), the development of which is dependent on byproducts of microbial metabolism in the rumen and the long-term impact of which points to differences in absorptive capacity of the ruminal epithelium. These data demonstrate that the rumen BCC can be influenced by early intervention. Ongoing work includes expansion of this dosing protocol to a cohort of 60 female calves, following rumen BCC development and the impact on MPE in the first lactation.

Key Words: rumen, calf, microbiota

407 Effects of Asparagopsis taxiformis and oregano leaves on methane emission, rumen fermentation, and lactational performance of dairy cows. H. A. Stefenoni*1, S. E. Räisänen1, S. F. Welchez1, D. E. Wasson1, C. F. Lage1, A. Melgar1, M. E. Fetter1, M. Hennessy2, B. Vecchiarelli2, J. Bender2, D. Pitta2, C. Yarish3, and A. N. Hristov1. 1The Pennsylvania State University, University Park, PA, 2University of Pennsylvania, Kennett Square, PA, 3University of Connecticut, Storrs, CT.

The objective of this experiment was to determine the effect of Asparagopsis taxiformis (AT) and oregano leaves (ORE) on enteric methane (CH4) emission, rumen fermentation, and lactational performance of dairy cows. Twenty Holstein cows (±SD) [95 ± 22.0 d in milk and 42 ± 2.6 kg milk yield (MY)] were used in a replicated 4 × 4 Latin square design with 4, 28-d periods. Treatments were a basal diet (CON) and CON supplemented with 0.25% AT (LAT), 0.50% AT (HAT), or 2.0% ORE of dry matter intake (DMI). Enteric gas emissions were measured using the GreenFeed system and rumen samples were collected by the ororunal technique. Data were analyzed using PROC MIXED of SAS with treatment and period in the model. Square and cow within square were random effects. Compared with CON, HAT decreased (P < 0.001) average daily CH4 emission and CH4 yield by 65% (380 and 131 g/d) and 55% (14.0 and 6.32 g/kg DMI), respectively, in experimental periods (P)1 and 2, but had no effect in P3 and P4. The differential response to HAT in P3 and 4 could be attributed to a decrease in bromoform concentration in AT over time (about 74% decrease in 5 mo of storage) observed in a separate experiment. ORE and LAT had no effect on CH4 emission. Compared with CON, HAT decreased (P ≤ 0.006) DMI, MY, and energy-corrected MY by 6.9, 5.7, and 7.3%, respectively. Milk fat and true protein concentrations were not affected by treatment, but lactose was decreased (P < 0.001) by HAT, compared with CON. Total VFA concentration and acetate:propionate ratio tended (P = 0.06) to be lowest for HAT. HAT and ORE increased (P = 0.02) the molar proportion of propionate compared with CON and LAT. Both AT treatments had greater concentrations of butyrate (P < 0.001) compared with ORE and CON. In this experiment, AT fed at 0.5% of DMI decreased CH4 emission by ≥55% in P1 and P2 of the experiment but the effect disappeared by P3 and P4, most likely due to a decrease in bromoform concentration. HAT also decreased DMI and milk production. ORE had no effect on CH4 emission and lactational performance of the cows.

Key Words: methane, Asparagopsis taxiformis, dairy cows

408 Survey of perceptions and practices of antimicrobial drug use in preweaned California dairy calves. E. Okello1, D. Williams1, R. Pereira2, T. Lehenbauer2, and S. Aly1, 1Veterinary Medicine Teaching and Research Center, School of Veterinary Medicine, University of California, Davis, Tulare, CA, 2Department of Population Health and Reproduction, School of Veterinary Medicine, University of California, Davis, Davis, CA.

The California dairy industry was surveyed in July 2017 to evaluate producers’ knowledge, perceptions and antimicrobial drug (AMD) use in preweaned dairy calves following the implementation of veterinary feed directive (VFD) changes in Jan 2017 and before the CA Senate Bill (SB) 27 effective Jan 2018. These regulations required veterinary oversight of medically important antimicrobial drugs (MIADs) administered to livestock. Questionnaires were mailed to 1,361 CA grade A dairies and calf ranches across CA and 169 (12%) responded. Most respondents (83%) were aware of the VFD and SB 27 changes. Use of antibiotics was perceived as important (77%) in raising preweaned dairy calves and judicious use of antibiotics was ranked as the most important antimicrobial stewardship practice (n = 134) among good record keeping, observing withdrawal periods, having a valid Veterinarian-Client-Patient-Relationship, and use of alternatives to antibiotics. Producers indicated that calves were exposed to AMD either directly through parenteral and oral dosage forms (78%) or indirectly through hospital milk (44%). Treating sick calves was the major indication for AMD use; however, few (12.7%) producers reported use of antibiotics to control or prevent disease (11%). Neomycin sulfate, chlorotetracycline, oxytetracycline and sulfamethazine were the most used AMD, though only 32% of the respondents kept a drug inventory. Decreased use of AMD post-VFD was noted in milk (10%) and grain (5%) and reported treatment records included date (82%), dose (44%) and route (15%) of AMD used. Only 13% and 16% respondents noted a decrease or increase in AMD costs respectively. Whereas most producers had knowledge of the VFD and SB 27, opportunities exist to improve AMD use practices, including record keeping and using AMD alternatives. The limited changes noted in AMD use could be due to the short period between the implementation of VFD and the time of the survey. Results of this survey provide a baseline for future evaluation of the impact of these regulatory changes and guide future best practice recommendations to promote judicious use of AMD.

Key Words: antimicrobial drug use, producer perceptions, dairy calf