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**PRODUCTION, MANAGEMENT, AND  
THE ENVIRONMENT: REDUCING THE  
ENVIRONMENTAL FOOTPRINT THROUGH  
NUTRITION AND MANAGEMENT**

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**1505 (W216) Methane and carbon dioxide emissions  
from manure of dairy cows fed red clover- or corn  
silage-based diets supplemented with linseed oil.**

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The objective of this study was to examine the effects of forage source (red clover: RC vs. corn silage: CS) and linseed oil (LO) supplementation of dairy cow diets on CH<sub>4</sub> and CO<sub>2</sub> emissions from manure storage. The diets contained 57% of RC or CS, on dry matter (DM) basis while LO was supplemented at 4% of dietary DM. For this purpose, twelve lactating cows were used in a block design with a 2 × 2 factorial arrangement of treatments. Manure (feces and urine) was collected from each cow on 2 consecutive days, mixed (1:1) with an inoculum from a bioreactor, and stored (at 20°C) under anaerobic conditions in glass bottles (6 replicates/cow) for 17 wk. Quantity of gas produced was measured daily and sampled to determine gas composition. The PROC MIXED of SAS was used to determine the effects of forage source, LO supplementation and their interaction, and statistical significance was declared at  $P \leq 0.05$ . Interactions between forage source and LO supplementation were not significant ( $P \geq 0.16$ ) for the measured variables. Compared to manure from cows fed RC-based diets, manure of cows fed CS-based diets emitted more ( $P < 0.01$ ) CH<sub>4</sub> (182 vs. 118 L/kg of organic matter, respectively) and CO<sub>2</sub> (134 vs. 91 L/kg of organic matter, respectively). Emissions of CH<sub>4</sub> and CO<sub>2</sub> from manure also increased ( $P \leq 0.05$ ) by 15% and 11% for CH<sub>4</sub> and CO<sub>2</sub>, respectively, when cows were fed LO-supplemented diets compared to those fed non-supplemented diets. Organic matter losses were higher ( $P < 0.01$ ) from manure of cows fed CS-based diets compared to manure of cows fed RC-based diets (30.6 vs. 22.5%, respectively). Organic matter losses of manure increased (+ 12%) with the addition of LO to the diets. Thus, it can be concluded that CH<sub>4</sub> and CO<sub>2</sub> emissions and organic matter losses from manure storage are higher if cow are fed CS-based diets compared to RC-based diets, and increase if LO is supplemented to the diet at 4% of dietary DM.

**Key Words:** manure, CH<sub>4</sub> emissions, forage source, linseed oil

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**1506 (W217) Life cycle assessment of heavy pig production in a sample of Italian farms.** G. Pirlo\*<sup>1</sup>, S. Carè<sup>2</sup>, G. Della Casa<sup>2</sup>, R. Marchetti<sup>2</sup>, G. Ponzoni<sup>2</sup>, V. Faeti<sup>2</sup>, V. Fantin<sup>3</sup>, P. Msoni<sup>3</sup>, P. Buttol<sup>3</sup>, and F. Falconi<sup>4</sup>, <sup>1</sup>*Consiglio per la Ricerca e Sperimentazione in Agricoltura, Cremona, Italy*, <sup>2</sup>*Consiglio per la Ricerca e Sperimentazione in Agricoltura, San Cesario S/P, Italy*, <sup>3</sup>*ENEA, Bologna, Italy*, <sup>4</sup>*LCA-Lab, Bologna, Italy*.

The purpose of this study was to estimate the environmental impact of breeding and fattening of heavy pig used for Italian cured ham production. For this purpose, a life cycle assessment (LCA) was applied to two samples of four breeding farms and of eight fattening farms. The functional unit was 1 kg of body weight of fattened pig. The system was subdivided into breeding and fattening phases. The following impact categories were analyzed: global warming (GW), abiotic resource depletion (AD), photochemical ozone formation (PO), acidification (AC), and eutrophication (EU). Reference units were kg of CO<sub>2</sub>eq for GW, kg of Sbeq for AD, kg of C<sub>2</sub>H<sub>4</sub>eq for PO, kg of SO<sub>2</sub>eq for AC, and kg of PO<sub>4</sub><sup>3-</sup>eq for EU. System boundaries included the following farm activities: 1) on-farm energy consumption (EC); 2) manure management (MM); 3) manure application (MA); 4) on-farm feed production (ONFP); 5) off-farm feed production (OFFP); 6) enteric fermentation (ENF); and 7) transports (TR). Average final body weight was 167 ± 5.2. LCA was performed with the support of SimaPro 7.3.3 software. The average environmental impacts associated with 1 kg of fattened pig body weight were: GW 3.43 kgCO<sub>2</sub>eq, AD 3.13 E-3 kg Sbeq, PO 1.78 E-3 kg C<sub>2</sub>H<sub>4</sub>eq, AC 5.37 E-2 kg SO<sub>2</sub>eq, EU 3.20 E-2 kg PO<sub>4</sub><sup>3-</sup>eq. Percentage contribution of breeding and fattening phases to GW, AC, PO, AC, and EU were: 30 and 70; 23 and 77; 31 and 69; 37 and 63; 30 and 70, respectively. Normalization analysis showed that the major contributions to the environmental impact of 1 kg of fattened pig body weight come from GW, AC and EU, whereas AD and PO are negligible.

**Key Words:** heavy pig, life cycle assessment, sustainability

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**1507 (W218) Control of water consumption in swine barns: One step-closer to real time management.**

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Providing enough quality water is essential for good livestock husbandry. Given that drinking water needs are farm- and management-specific, water-metering equipment to obtain accurate measurements of water use should be applied in each location. The aim of this study was to use new technologies to monitor and predict daily water consumption of fattening pigs. To monitor water consumption, a real-time sensor monitoring system was installed and set in the fattening unit of

one Spanish commercial swine farm. The fattening unit consisted of two buildings, both including about 1000 pigs. Each building was filled with one-only batch of pigs, 60 d of life at the entrance. Pigs were allotted in pens of 10 pigs, with a stock density of 0.70 m<sup>2</sup>/pig, natural ventilation, partly slatted concrete flooring and one hopper and one cup drinker per pen. Feed and water were available ad libitum. The metering system consisted in one flow and one temperature sensors, connected to a processing unit which polled the data from these devices and uploaded it to the database. Four batches of pigs were followed up in each building, registering water intake, room temperature and daily control of mortality and health. Water consumption was daily calculated per pig from 60 to 150 d of life. Simple linear regression was conducted to predict water intake in L per animal and day from age in days using the REG procedure of SAS. As expected, water consumption was highly correlated to age (r square = 0.72). In the experimental farm where this measurement was conducted, the most statistically valid equation to predict water consumption was  $y = 0.0324x - 0.2081$ , where y is individual daily water intake (L) and x is age in days. Therefore, an average water consumption range of 1.73 to 4.65 (at 60 to 150 d of age) L per animal and day was obtained. Values found in bibliography differ significantly among different authors and are higher than the mean values obtained in the present study, being the average difference 22.4% with the lower interval reviewed in the bibliography and 48.9% with the upper one. This system allows monitoring water consumption in a particular facility and then detecting in an early stage any significant deviation of water intake from the expected range. In addition, knowing water consumption in detail also allows ensuring proper dosing rate of medication provided through the watering system.

**Key Words:** water consumption, monitoring, pigs

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**1508 (W219) Increasing milk yield affects sustainability of dairy cattle production in terms of cultural energy use efficiency.** H. Koknaroglu\*, H. Saglam, and O. Koskan, *Suleyman Demirel University, Isparta, Turkey.*

Purpose of this study was to conduct cultural energy analyses of dairy cows having different levels of milk yield. Cultural energy (CE) is the energy other than solar energy needed to produce food and fiber and energy output/input ratios is one of the most useful methods to examine the potential long-term sustainability of various agricultural practices and this analysis is performed to quantify the energy return from products produced relative to the CE invested to produce the product. Study was conducted at a commercial dairy farm, which specialized only in dairying and had 175 heads lactating cow during a production year which covered Dec. 15, 2010, through Dec. 15, 2011. At the farm lactating cows were grouped into four levels according to their milk yield and were fed accordingly. Groups were classified as low (LO), low-intermediate

(LI), intermediate (IM) and high (HI). At the first visit to the farm a file that recorded milk production of each cow and number of lactating cows per group was formed and these records were recorded for every day. Feed intake of cows was also recorded every day. Cultural energy used for feed and other production inputs was derived from their corresponding feed consumption and resource expenditure and their corresponding values from literature. Energy value of the milk comprised the output. Total cultural energy expenditure increased as milk yield increased ( $P < 0.05$ ). Cultural energy expended for feed constituted more than half of the total cultural energy expenditure and increased as milk yield increased ( $P < 0.05$ ). Cultural energy expended per kg milk and per Mcal protein energy decreased as milk yield increased and was lowest for HI group ( $P < 0.05$ ). Energy use efficiency defined as the Mcal input/Mcal output was better for HI and worse for LO and as milk yield increased energy use efficiency became better ( $P < 0.05$ ). Results show that higher yielding lactating cows convert cultural energy into food energy better than lower yielding cows. Thus optimum milk yield not interfering cows' health should be sought for sustainable dairy production.

**Key Words:** dairy cattle, milk yield, sustainability, cultural energy

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**1509 (W220) Effect of astaxanthin production by the yeast *Phaffia rhodozyma* on growth performance, blood profiles, meat quality, and slurry noxious gas emission in broilers.** S. Kim, S. D. Upadhaya, and I. H. Kim\*, *Dep. of Animal Science, Dankook University, Cheonan, South Korea.*

A ban on specific antibiotic growth promoters in animal diets was introduced in the world from 1980s, on the basis of the Precautionary Principle. A prospective alternative to antibiotics that is currently being evaluated is yeast and its derivative products. *Phaffia rhodozyma* is discovered from the yeast that is strikingly different from the other pigmented yeasts in producing the carotenoid pigment astaxanthin. Astaxanthin exhibits a wide variety of biological activities, including antioxidative, anti-*Helicobacter pylori*, anticancer and anti-inflammatory effects in animals. A total of 432 1-d-old male broilers (Arbor Acres) were used in a 29-d experiment and each dietary treatment consisted of nine replicate cages, with 16 broilers per replicate. Birds were randomly allotted to 1 of 3 corn-soybean meal based diets supplemented with 0 mg (CON, basal diet), 1000mg (TRT 1, CON + astaxanthin production 0.1%) or 2000mg (TRT 2, CON + astaxanthin production 0.2%) per kg feed, giving an intake of approximately 0 mg, 2.3 mg, and 4.6 mg astaxanthin/kg feed, respectively. All broilers were fed maize-soybean meal-based diets that were formulated to meet or exceed the National Research Council (1994), nutrient recommendations. The broilers were weighed and feed intake were recorded on d 14 and 29 for calculating BW gain (BWG), feed intake (FI), and feed conversion ratio

(FCR). At d 29, 2 birds were randomly selected from each replication (18 broilers per treatment) and slaughtered by cervical dislocation for meat quality. All data were subjected to GLM procedures of SAS (1996) as a randomized complete block design, with pen as the experimental unit. Differences among treatments were separated by Duncan's multiple range tests;  $P < 0.05$  was considered statistically significant. The inclusion of astaxanthin linearly improved ( $P < 0.05$ ) body weight gain in the phase 2 (969, 989, 1024 g; 15~29 d) and during the overall experimental period (1377, 1401, 1439 g; 1~29 d). No significant linear effects were observed in the red blood cells, white blood cells, and lymphocytes in response to TRT1 and TRT2 ( $P > 0.05$ ). The ammonia emission from slurry obtained from broilers in the CON group was significantly higher than that of slurry obtained from broilers in the TRT1 and TRT2 (17.98 vs. 14.42, 14.32 ppm;  $P < 0.05$ ). Taken together, these results indicated that supplementation with astaxanthin could improve body weight gain and reduced slurry ammonia emission in broilers.

**Key Words:** blood profiles, broiler, noxious gas emission, *Phaffia rhodozyma*

**1510 (W221) Assessing variability in whole-farm environmental impact estimates using a partially-stochastic beef production model.** K. A. Johnson, and R. R. White\*, *Washington State University, Pullman.*

Environmental impact (EI) studies often aim to identify resource use and greenhouse gas (GHG) emissions from an average production system without accounting for biological variability. These models are frequently used as means to compare EI between systems but they do not account for the variability expected in EI calculations. Our objectives were to develop a partially-stochastic model of beef EI and to use that model to examine implications of increased efficiency through improved calving rate. A whole-system model of beef production EI was adapted to account for the variability in land use, water use and GHG estimates. Variability in animal production parameters was not assessed. Three scenarios were tested: LOW (80% conception), CON (89% conception) or HIGH (100% conception). Projected changes in calving rate were compared with and without accounting for EI ranges. Reported state average crop yield and irrigation values were collected over a 20-yr period and used to represent variability in yield and irrigation estimates. Equations for CH<sub>4</sub> and N<sub>2</sub>O were varied by their reported confidence bounds. Land use was expressed in m<sup>2</sup>/kg hot carcass weight beef (HCWb), water use was in L/kg HCWb and GHG were calculated as CO<sub>2</sub>-equivalents (CO<sub>2</sub>e)/kg HCWb. The LOW scenario (Table 1510) had the greatest EI while the HIGH scenario had the lowest. This is in agreement with current literature relating efficiency to EI. When the variability around each environmental estimate was accounted for (Table 1510), the ranges described by the model

overlapped considerably for all levels of operation efficiency. As a percentage of the mean, crop yield variability resulted in land use estimates with an error bound of about 200% while GHG and water use varied by about 100%. Variability associated with EI estimates was typically greater than the projected differences between treatments simulated. The variability may be consistent with true biological variability thus before accurate assessments of on-farm management to improve EI can be conducted, better methods to understand and account for the causes of this variability must be developed.

**Key Words:** environmental impact, variability, beef production

**Table 1510.** Means and ranges of EI metrics across efficiency scenarios

Scenario	Land Use (m <sup>2</sup> /kg HCWb)	Water Use (L/kg HCWb)	GHG (CO <sub>2</sub> e/kg HCWb)
LOW	82 (50.1–246.9)	258.1 (226.9–328.1)	21.5 (10.4–34.3)
CON	75 (45.9–224.5)	265.8 (217.7–315.0)	19.9 (9.8–31.7)
HIGH	68 (42.0–203.3)	258.1 (211.1–306.0)	18.5 (9.1–29.3)

**1511 (W222) Environmental assessment of a representative grass-finished beef operation in southern Pennsylvania.** J. A. Dillon\*<sup>1</sup> and C. A. Rotz<sup>2</sup>, <sup>1</sup>*Dep. of Animal Science, Pennsylvania State University, University Park,* <sup>2</sup>*USDA-ARS Pasture Systems and Watershed Management Research Unit, University Park.*

The objective of this study was to quantify environmental impacts of a representative grass-finished beef operation in southeastern Pennsylvania. A farm-gate life cycle assessment was conducted using the Integrated Farm System Model to estimate greenhouse gas emissions, reactive nitrogen loss, and water and energy use. Parameters describing the operation were obtained from published survey results of pasture finishing beef producers in the northeastern United States. Cattle were rotationally grazed on 101 ha of perennial cool season grass-legume mixed pasture. Supplementation included silage and dry hay produced on the farm. Alfalfa silage was purchased for winter feeding and the final finishing phase. Net forage production was 652 t DM. The Angus herd consisted of 80 cows, 12 replacement heifers, 60 stockers, and 59 finishing cattle on a spring calving cycle. Calf weaning weight and average mature cow weight were 182 kg and 454 kg, respectively. Cattle were finished at 21 mo of age on high quality pasture and silage, with an ADG of 0.9 kg/d and shrunk body weight (SBW = 96% of live weight) of 477 kg. Simulation results over 25-years of historical weather for Lancaster, PA were sensitive to pasture management. When pastures were limed, average annual carbon footprint was 14.4 ± 0.5 kg CO<sub>2</sub>e/kg SBW sold, requiring 27.3 ± 1.9 MJ of energy/kg SBW sold. When lime was not applied to pastures, the average annual carbon footprint was 12.6 ± 0.4 kg CO<sub>2</sub>e/kg SBW, requiring 12.6 ± 0.7 MJ of energy/kg SBW. Total water use

(water footprint) for both scenarios was  $13,900 \pm 1350$  L H<sub>2</sub>O/kg SBW, and the water footprint excluding rainfall was  $41 \pm 2$  L H<sub>2</sub>O/kg SBW. The reactive nitrogen footprint was  $91.0 \pm 29.5$  g reactive N loss/kg SBW. Generating data related to the environmental impacts of grass finished beef production provides a baseline for management decisions intended to improve the sustainability of production systems.

**Key Words:** grassfed beef, environment, carbon footprint

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**1512 (W223) A modeling assessment of cow management decisions, sustainability and durability of beef production systems.**

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Sophisticated calculations of system durability should be incorporated into sustainability assessments. The objective of this study was to assess how cow herd management affected the environmental impact (EI), economic viability and stability of a simulated beef herd. A modeling approach was used incorporating dynamic simulation of cattle genetic improvement with cradle-to-farmgate EI and income over feed costs (IOFC). Two 15-yr systems were simulated, one looking at culling rates of 1, 5, 10, 15, or 20% (CULL) and one assessing culling rate differences with a trauma (random removal of 30% of the breeding herd) occurring in the fifth year (CULL+T). Yearly changes in genetic merit were simulated using Markov Chain Monte Carlo sampling, expected progeny differences and the Key equation. Changes in conception/birth rate, mature weight, offspring daily gain, birth weight, weaning weight and yearling weight were tracked. Land use, water use and greenhouse gas emissions (GHG) and IOFC per kg hot carcass weight beef (HCWb) produced were calculated annually and yearly change was compared across culling levels. Trauma effects were calculated by interpolating across the points where the trauma occurred and calculating the cumulative difference between the CULL+T and interpolated lines. In the CULL scenario, the 15% cull rate resulted in the largest average annual improvement in EI and IOFC. Average yearly reductions in land, water and GHG were  $2.4 \pm 5.7$  m<sup>2</sup>/kg HCWb,  $29 \pm 77$  L/kg HCWb and  $0.26 \pm 0.53$  kg CO<sub>2</sub>-equivalents (CO<sub>2</sub>e)/kg HCWb. Annual change in IOFC was  $\$0.03 \pm \$0.09$ /kg HCWb. In the CULL+T scenario, a 2-yr system depression occurred, and IOFC and EI were compromised. Culling at 10% was the least stable option; beef produced during the 2-yr trauma period had greater land use, water use and GHG ( $4.0$  m<sup>2</sup>/kg HCWb,  $420$  L/kg HCWb and  $3.74$  kg CO<sub>2</sub>e/kg HCWb) compared with the no trauma line. Culling at 5% was the most stable treatment; environmental changes were only  $3.4$  m<sup>2</sup>/kg HCWb,  $374$  L/kg HCWb and  $3.26$  kg CO<sub>2</sub>e/kg HCWb. Culling at 1% was the most economically stable treatment; IOFC decreased  $\$0.27$ /kg HCWb, substantially lower than losses seen with 10 or 15% culling ( $-\$0.32$ /kg HCWb).

Management that best optimized EI and IOFC did not always result in the most durable system. This model presents one framework for assessing durability that is applicable to multiple cow management decisions.

**Key Words:** cow-calf, sustainability, durability

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**1513 (W224) Nitrogen excretion from beef cattle for 6 cover crop mixes as estimated by a nutritional model.**

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The objective of this study was to predict fecal and urinary N excretion for different maturities of beef cattle using model simulations based on compositional analysis of cover crop mixes. Two replicates of six forage mixes containing differing legumes with and without rape were grown under dryland conditions at Dakota Lakes Research Farm near Pierre, SD, in 2010 and 2011. Samples were analyzed for DM, CP, soluble CP, ADF, NDF, acid detergent insoluble CP, neutral detergent insoluble CP, lignin, starch, simple sugars and crude fat. Data was entered into the Large Ruminant Nutrition System model (LRNS) for estimation of N excretion. Two animal scenarios were analyzed: a non-lactating, pregnant beef cow and replacement beef heifer. Dry matter intake was set to 2.33% of BW for all simulations. The experiment was a split-plot arrangement of a randomized complete block with animal type and cover crop mixture as the whole plot and harvest date as the sub-plot. Forage mix and harvest date were treated as fixed factors and replications were considered random. Student's *t* test was used to separate mean effects when an *F* test was significant ( $P = 0.05$ ). Crude protein concentrations of forage mixes were always at least 14% but CP content was affected by month within year ( $P < 0.01$ ). Predictions of N utilization, except kg/d of fecal N excreted, were affected by forage mix. Fecal N excretion ranged from 33.6 to 43.7% and urinary excretion from 52.5 to 58.8% of N intake. Predicted N intake varied by month within year due to varied CP concentration of the mixes. Differences in N intake resulted in difference in the amount of predicted N excreted (kg/d) for cows, but not heifers. The predicted percentage of N intake excreted in feces did not differ by animal maturity. There was an animal maturity by month within year interaction for urinary excretion both when expressed as total kg/d excreted and percentage of N intake. Urinary N excretion varied from a low of 43.8% of intake for heifers to a high of 66.4% for cows. These types of estimates may be useful to make assessments about N flows in crop-livestock systems.

**Key Words:** forage, nitrogen, beef cattle

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**1514 (W225) Effect of crude glycerin associated with energy sources on enteric methane emission from finishing Nellore bulls on pasture in the dry season.**

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The objective of this study was to evaluate the enteric methane emission, average daily gain (ADG) and daily carcass gain (GC) of finishing Nellore young bulls maintained on tropical pasture during the dry season and supplemented with 28% crude glycerin (CG) in the supplement (DM basis) and replacing corn or soybean hulls, with or without a source of oil. Thirty six Nellore young bulls with  $510.02 \pm 40.66$  kg average initial BW were distributed in a completely randomized design (three animals per paddock and three paddocks per treatment) with four experimental treatments and nine replicates in a  $2 \times 2$  factorial arrangement (high or low starch, with or without a source of oil). Paddock was the experimental unit, and the model effects included each treatment. The animals were raised (finishing phase) *Brachiaria brizantha* cv. Xaraés in the dry season (June to October 2013) with the treatments supplemented at the rate of 1000 g/100 kg BW. The supplements were: T1, CG with high starch (corn), T2, CG with low starch (soybean hulls), T3, CG with high starch and a source of oil (corn and soybeans) and T4, CG with low starch and a source of oil (soybean hulls in soybean grain). The sulfur hexafluoride SF<sub>6</sub> tracer method was used to measure eructated CH<sub>4</sub>. Average daily gain (ADG) was obtained by weighing animals at the beginning and end of methane measurement period (28 d). The animals were slaughtered at d 133 of the trial with determined carcass weight. Data were analyzed using the PROC GLM procedure of SAS with significance level at  $P < 0.05$  including daily carcass gain (GC, kg d<sup>-1</sup>) and average daily gain (ADG, kg d<sup>-1</sup>) of the animals. Methane emission was expressed per year (kg CH<sub>4</sub> yr<sup>-1</sup>), per day (g CH<sub>4</sub> d<sup>-1</sup>), per kilogram of carcass produced (kg CH<sub>4</sub> kg CAR<sup>-1</sup>) and per kilogram of average daily gain (kg CH<sub>4</sub> kg ADG<sup>-1</sup>). Differences were not detected ( $P > 0.05$ ) between treatments with average values of 0.65 kg d<sup>-1</sup>, 0.68 kg d<sup>-1</sup>, 47.22 kg yr<sup>-1</sup>, 129.37 g d<sup>-1</sup>, 0.20 kg CH<sub>4</sub> kg CAR<sup>-1</sup> and 0.25 kg CH<sub>4</sub> kg ADG<sup>-1</sup>, respectively. The average daily weight and enteric methane emission of Nellore bulls on pasture was not affected by supplementation of crude glycerin.

**Key Words:** beef cattle, glycerol, greenhouse gas

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**1515 (W226) Enteric methane emission from beef cattle fed diets containing crude glycerin associated with energy sources.**

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The objective of this study was to evaluate the enteric methane emission of Nellore young bulls finished in feedlot fed diets containing 10% crude glycerin (CG; DM basis) replacing corn or soybean hulls, with or without a source of oil. Twenty eight Nellore young bulls with  $395 \pm 32$  kg of average initial body weight and  $20 \pm 2$  mo were distributed in a completely randomized design with four experimental treatments and seven replications in a  $2 \times 2$  factorial arrangement (high or low starch, with or without a source of oil). The treatments were: T1, CG with high starch (corn), T2, CG with low starch (soybean hulls), T3, CG with high starch and a source of oil (corn and soybeans), and T4, CG with low starch and a source of oil (soybean hulls in soybean grain). All treatments contained 60% corn silage and 40% concentrate. The sulfur hexafluoride SF<sub>6</sub> tracer method was used to measure eructated CH<sub>4</sub>. Data were analyzed using the PROC GLM procedure of SAS with significance level at  $P < 0.05$ . Methane emission was expressed per day (g CH<sub>4</sub> d<sup>-1</sup>), per kilogram of carcass produced (g CH<sub>4</sub> kg CAR<sup>-1</sup>) and per kilogram of average daily gain (g CH<sub>4</sub> kg ADG<sup>-1</sup>). Differences were not detected between treatments for all variables ( $P > 0.05$ ). However, when compared the effects between factors, differences were detected, with average values of 118.74 and 164.40 g CH<sub>4</sub> d<sup>-1</sup> ( $P < 0.001$ ), 101.93 and 140.78 g CH<sub>4</sub> kg ADG<sup>-1</sup> ( $P < 0.01$ ), 141.14 and 180.46 g CH<sub>4</sub> kg CAR<sup>-1</sup> ( $P < 0.02$ ) to the factors with or without a source of oil, respectively. The starch in the diet did not affect enteric methane emission for all variables ( $P > 0.05$ ). However, may be affected when an oil source with crude glycerin is added in diet Nellore young bulls finished in feedlot.

**Key Words:** environment, glycerol, ruminant

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**1516 (W227) Using fecal phosphorus, calcium and ash excretion to predict total and inorganic phosphorus intake of beef cattle consuming a forage-based ration.**

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To mitigate the environmental and economic impact of phosphorus (P) supplementation in excess of beef cattle requirements, producers are currently being encouraged to re-evaluate P supplementation strategies. One of the major limiting factors in doing so is that P intake of grazing cattle is generally unknown. The objective of this evaluation was to determine the ability of fecal total P (P<sub>t</sub>) and fecal inorganic P (P<sub>i</sub>), calcium (Ca) and ash fractions to explain variation in P<sub>t</sub> and P<sub>i</sub>

intake. Results of dietary and fecal  $P_i$ ,  $P_e$ , Ca and ash analyses were obtained from two previous experiments that quantified P excretion of beef cattle supplemented with P from different dietary sources. Steers included in each of the two experiments were fed a basal ration of low P chopped grass hay (0.10 and 0.13%) and supplemented with increasing levels of dicalcium phosphate (0, 33, 65, 95 g/d) or increasing levels of corn gluten feed (0, 0.5, 1.0, 1.5 kg/d) to provide increasing levels of dietary P that were below, met or exceeded NRC recommended P requirements. Steers in the dicalcium phosphate trial were  $304 \pm 22$  kg BW and steers in the corn gluten trial were  $427 \pm 79$  kg BW. Daily feed intake measurements and total fecal collections were used to quantify  $P_i$ ,  $P_e$ , Ca and ash content (expressed as a percentage of DM) of feed offerings, orts and feces. Values were then used to determine respective nutrient intake and excretion. All statistical analyses were conducted using JMP Pro. Interpretation of the results of an initial factor screening indicated that fecal percentage of  $P_i$ ,  $P_e$ , Ca and ash explained a significant ( $P < 0.05$ ) portion of the variation in  $P_i$  and  $P_e$  intake. Full four-way factorial regression models were generated to predict  $P_i$  ( $R^2 = 0.79$ ;  $P < 0.0001$ ) and  $P_e$  ( $R^2 = 0.83$ ;  $P < 0.0001$ ) intake expressed in g per d using the Fit Model procedure. Refinement of the full factorial model using the reverse stepwise personality supports the use of the full factorial design, as removal of higher-order interactions resulted in a reduction of the  $R^2$  value. These results indicate the ability of fecal  $P_i$ ,  $P_e$ , Ca and ash percentages and their interactions to explain the majority of the variation in  $P_i$  and  $P_e$  intake. These and additional measurements could be utilized to develop a fractional P intake prediction model for beef cattle.

**Key Words:** beef, phosphorus, prediction

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**1517 (W228) Influence of low doses tannins extract addition on the presence of *Escherichia coli* in feces of beef cattle.** T. D. J. Heras<sup>\*1</sup>, I. Enriquez<sup>1</sup>, B. J. Cervantes<sup>2</sup>, S. M. Gaxiola<sup>1</sup>, J. A. Romo<sup>1</sup>, and R. Barajas<sup>1</sup>, <sup>1</sup>FMVZ-Universidad Autónoma de Sinaloa, Culiacan, México, <sup>2</sup>Ganadera los Migueles, S.A. de C.V., Culiacan, México.

Feces of twenty bulls  $430 \pm 4.5$  kg (75% Brahman breed with remainder of Brown Swiss or Charolais) fed finishing diets were used to determine the influence of Influence of low doses tannin extract addition on the presence of *Escherichia coli* in feces of beef cattle. From each of four commercial feedlot pens containing 70 bulls, five bulls were randomly selected and moved to squeeze and fecal samples were taken. Feces of five bulls from a common pen were pooled and constitute the experimental unit. Pooled fecal sample were divides in four portions of proximately 60 g (wet basis), one portion was used for DM determination, and remainder three fecal samples by pen were randomly assigned for addition or not tannins extract (TE) as follows: 1) Feces without extra addition (Control); 2) Control plus 0.1008 g of condensed

tannins extract (CTE); and 3) Control plus 0.1008 g of hydrolyzable tannins extract (HTE). TE was fed as SilvaTeam (Argentina). Feces was thoroughly mixed and placed on piece of Kraft paper underground 0.70 m outside of pen and covered with a  $0.4 \times 0.4 \times 0.25$  cm metal mesh cage, and exposed to feedlot environment during 0, 24, 48 or 72 h. Aliquots from each TE schedule, exposed time and pen were taken, and by triplicate placed in a *E. coli* selective medium and incubated during 24 h at 45°C, after incubation Colonies Former Units (CFU) were counted and transformed to  $\log_{10}$ CFU. Results were analyzed by ANOVA for a completely randomized design with a  $3 \times 4$  factorial arrangement. Feces DM were 27.27%, and then TE dose was 0.6% of fecal DM. At 0 h, *E. coli* presence was 4.19, 4.08, and 4.28  $\log_{10}$ CFU for Control, CTE and CTH, respectively. At 48 h CTE tended ( $P = 0.07$ ) to decrease *E. coli* presence compared with 0 h (4.08 vs. 1.13  $\log_{10}$ CFU). At 72 h CTE tended to diminished ( $P = 0.07$ ) *E. coli* in bovine feces with means values of 4.07, 3.22 and 1.76  $\log_{10}$ CFU for Control, CTE and HTE, respectively. It is concluded; that the addition of condensed tannin extract at very low concentration could contributes to reduce the *Escherichia coli* population in the feces of feedlot cattle.

**Key Words:** *Escherichia coli*, bovines, tannins extract

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**1518 (W229) Phosphorus excretion in beef steers as impacted by increasing levels of dicalcium phosphate supplementation.** E. A. Riley,

D. D. Harmon\*, J. K. Smith, A. L. Zezeski, S. P. Greiner, K. F. Knowlton, and M. A. McCann, Virginia Polytechnic Institute and State University, Blacksburg.

Feeding phosphorus (P) to grazing cattle in excess of requirements can lead to increased P in surface water. The objective of this study was to determine the impact of increasing levels of dicalcium phosphate as a supplemental inorganic source of P. Eight Hereford steers,  $304 \pm 22$  kg of BW, were randomly assigned to one of four dietary P treatments in a  $4 \times 4$  replicated Latin square. Steers were fed a ration containing  $80 \pm 1\%$  chopped grass hay (0.10%P) and 0, 33, 65 or 95 g/d of dicalcium phosphate. All steers were supplemented with 0.79 kg/d beet pulp, 0.23 kg/d rumen-protected fat supplement and 20 g/d trace mineral salt. Diets were formulated to approximate 50, 100, 150, and 200% of dietary P requirement for a growing beef steer. Steers were housed in individual pens and fitted with total fecal collection bags. Each period consisted of a 9-d adjustment period followed by a 5-d collection period. Following the final collection of each period, a 10-mL blood sample was collected via jugular venipuncture and analyzed to determine plasma inorganic P ( $P_i$ ) concentration. Samples were analyzed for  $P_i$  and total P ( $P_e$ ) using the molybdovanadate yellow and blue methods, respectively. Data were analyzed using the PROC GLIMMIX procedure of SAS with a model that included diet and period. Linear,

quadratic and cubic treatment effects were evaluated using preplanned contrasts. Dietary P increased linearly ( $P < 0.05$ ) across diets at levels of 3.88, 10.45, 16.47 and 22.28 g/d, respectively. Total P excretion increased linearly with increasing dietary P content (7.73, 11.41, 15.50, and 21.51 g/d;  $P < 0.05$ ) as did  $P_i$  excretion (3.19, 6.51, 10.50, 14.67 g/d,  $P < 0.05$ ) and thus  $P_i$  excretion was highly correlated ( $P < 0.05$ ;  $r = 0.94$ ) with  $P_i$  excretion. Apparent P digestibility increased quadratically with increasing dietary P (-110.67, -9.32, 5.83, and 3.75%,  $P < 0.05$ ), with negative digestibility's suggesting dietary P levels below requirement. P solubility ( $[P_i/P_e] \times 100$ ) increased quadratically with increasing dietary P (39.71, 56.64, 66.60, and 67.85%,  $P < 0.05$ ), indicating that the percentage of water soluble P increases when feeding P levels above requirements. Similar to fecal P trends, blood plasma  $P_i$  increased linearly with increasing levels of dietary P (6.40, 8.35, 8.72, and 9.19 mg/dL,  $P < 0.05$ ). Beef cattle operations can reduce environmental impacts by closely matching P supplementation to P requirements.

**Key Words:** beef, phosphorus, excretion

**1519 (W230) Estimation of heat production and energy conversion efficiency using real time measurements of methane and carbon dioxide fluxes in mid-lactation holstein cows.** A. B. D. Pereira\*<sup>1</sup>, A. F. Brito<sup>1</sup>, and S. A. Utsumi<sup>2</sup>, <sup>1</sup>University of New Hampshire, Durham, <sup>2</sup>Dep. of Animal Science, Michigan State University, Hickory Corners.

Real time measurements of  $CH_4$  ( $Q_{CH_4}$ ) and  $CO_2$  ( $Q_{CO_2}$ ) fluxes were used in a pilot study to estimate heat production<sup>1</sup> (HP) and energy conversion efficiency in lactating dairy cows. Oxygen utilization ( $Q_{O_2}$ ) was estimated according to the respiration quotient<sup>2</sup>. Eleven multiparous and four primiparous lactating Holstein cows averaging  $176 \pm 34$  DIM,  $42.9 \pm 6.8$  kg of milk yield and  $681 \pm 48$  kg of BW were blocked by DIM, parity, and DMI (as % of BW) and, within each block, randomly assigned to 1 of 2 treatments: restricted intake (RI) (90% DMI) or ad libitum intake (AI) according to a crossover design. Each experimental period lasted 22 d with 14 d for treatments adaptation and 8 d for data and sample collection. Diets contained (DM basis): 40% corn silage, 12% grass-legume haylage, and 48% concentrate. Spot gas measurements were taken in 5-min sampling periods from all cows using a portable automated head chamber system [GreenFeed (GF); C-Lock Inc., Rapid City, SD] with intervals of 12 h between the two daily samplings. Sampling points were advanced 2 h from a day to the next to yield 14 gas samplings/cow over 7 d to account for diurnal variation in  $Q_{CH_4}$  and  $Q_{CO_2}$ . Data were analyzed using the Fit Model procedure in JMP, and least square means are reported. Cows on RI converted more feed gross energy<sup>3</sup> into milk energy<sup>4</sup> (28.3 vs. 27.0%, SEM = 0.63;  $P = 0.04$ ) and more DMI into metabolizable energy<sup>5</sup> than AI cows (11.8 vs. 11.3 MJ/kg of DMI; SEM = 0.22  $P =$

0.02). Conversely, RI cows yielded more HP/kg of DMI (6.65 vs. 6.36 MJ/kg; SEM = 0.18;  $P = 0.04$ ). Our results suggest that the proposed methodology has potential to identify more efficient dairy cows according to real time measurements of  $Q_{CH_4}$  and  $Q_{CO_2}$  using the GF.

Equations used for estimations:

<sup>1</sup>Estimated

$$HP_{MJ/cow/d} = [(3.86 \times Q_{O_2}) + (1.2 \times Q_{CO_2}) - (0.518 \times Q_{CH_4})] \times 4.184/1000 \text{ (Brouwer, 1965)}$$

$${}^2Q_{O_2}/Q_{CO_2} = 0.95 \text{ (Madsen et al., 2010)}$$

<sup>3</sup>Gross energy

$$\text{intake}_{MJ/cow/d} = [\text{dietary CP}_{\%} \times \text{DMI}_{kg} \times 17 \times 0.6] \times 4.184 \text{ (IPCC, 2006)}$$

<sup>4</sup>Milk

$$\text{energy}_{MJ/cow/d} = [(0.384 \times \text{fat}_{\%}) + (0.223 \times \text{protein}_{\%}) + (0.199 \times \text{lactose}_{\%}) - 0.108] \times \text{milk yield}_{kg/cow/d} \text{ (AFRC, 1993)}$$

<sup>5</sup>Metabolizable

$$\text{energy}_{MJ/cow/d} = \text{HP} + \text{Milk energy} \pm (19.99 \times \text{kg of mobilized weight}) \text{ (AFRC, 1990)}$$

**Key Words:** energy conversion efficiency, heat production, GreenFeed

**1520 (W231) Effect of dietary nitrate and organic copper supplementation on dairy enteric methane and nitrous oxide emissions.** S. J. Werth\*<sup>1</sup>, Q. Wang<sup>1</sup>, C. J. Neumeier<sup>1</sup>, G. Getachew<sup>1</sup>, D. H. Putnam<sup>1</sup>, A. R. Castillo<sup>2</sup>, and F. M. Mitloehner<sup>1</sup>, <sup>1</sup>University of California-Davis, Davis, <sup>2</sup>University of California Cooperative Extension, Merced.

Previous research on nitrate ( $NO_3^-$ ) supplementation in dairy cattle diets demonstrated that  $NO_3^-$  is effective in decreasing methane ( $CH_4$ ) production; however, it also induced nitrous oxide ( $N_2O$ ) production under the rumen simulated conditions. One possible strategy to mitigate concomitant  $N_2O$  emission is by enhancing the activity of nitrous oxide reductase ( $N_2OR$ ) to increase the reduction of  $N_2O$  to nitrogen gas ( $N_2$ ). Nitrous oxide reductase is a metalloenzyme with one enzyme that contains 12 copper (Cu) atoms to be fully active. Copper availability under rumen condition is typically low, which could impede  $N_2OR$  activity and therefore the reduction of  $N_2O$  to  $N_2$ . Organic (OG), compared to inorganic (IN) Cu, might have a higher availability to microbes under rumen conditions. Organic Cu forms strong chelation complexes with small organic compounds, which renders the Cu complex high stability under the rumen environment (Stevenson, 1994), this may result in higher availability of OG Cu. The present study investigated the effect of OG vs. IN Cu on

decreasing  $\text{NO}_3^-$  induced  $\text{N}_2\text{O}$  production in the simulated rumen using in vitro gas production systems. Gas and liquid samples were obtained from the system every two-hours and were analyzed for carbon dioxide,  $\text{CH}_4$ ,  $\text{N}_2\text{O}$ ,  $\text{NO}_3^-$ , nitrite, and ammonium ( $\text{NH}_4^+$ ) concentrations. Nitrate was totally consumed after 8h. Nitrate decreased ( $P < 0.01$ ) ruminal  $\text{CH}_4$  by 30.1% but increased ( $P < 0.001$ )  $\text{N}_2\text{O}$  production from 0 to 7.1 uL/g DM. Organic Cu was effective in decreasing ( $P < 0.05$ )  $\text{NO}_3^-$  induced  $\text{N}_2\text{O}$  production by 24.7% during enteric fermentation. Ammonium concentration in the rumen fluid was lower ( $P < 0.01$ ) with the supplementation of  $\text{NO}_3^-$  compared to urea especially during the early incubation period. In summary,  $\text{NO}_3^-$  and OG Cu feeding decreased ruminal  $\text{CH}_4$  and  $\text{N}_2\text{O}$  production concomitantly although total greenhouse gas gasses were not affected by OG Cu supplement.

**Key Words:** cattle, greenhouse gas, nitrous oxide reductase

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**1521 (W232) Influence of tannins extract addition on in vitro gas production of feces from beef**

**cattle.** R. Barajas\*, E. X. Murillo, N. Castro, and E. A. Velazquez, *FMVZ-Universidad Autónoma de Sinaloa, Culiacan, México.*

Feces of 15 bulls  $392 \pm 5.1$  kg (75% Brahman breed with remainder of Brown Swiss or Charolais) fed finishing diets were used an experiment to determine the influence of tannins extract addition on in vitro gas production of feces from beef cattle. From each of three commercial feedlot pens containing 72 bulls, five bulls were randomly selected and moved to squeeze and fecal samples were taken. Feces of five bulls from a common pen were pooled and constitute the experimental unit. Pooled fecal sample were divides in three portions of proximately 200 g (wet basis), one portion was used for DM determination, and two remainder fecal samples by pen were randomly assigned to one of two treatments: 1) Feces without extra addition (Control); 2) Control plus addition of 2 g of a tannins extract/100 g of wet feces (TE). Tannins extract were proportioned as SilvaFeed Bypro (SilvaTeam, Argentina), a premix integrated mainly for condensed tannin from quebracho tree blended with a minor proportion of hydrolyzable tannins from chestnut. Aliquots of 50 g (wet basis) were placed in 600 mL flask (three by treatment), closed and connected with a plastic pipe to a 250 mL glass graduate probet inverted in a water bath. Flask were incubated at  $37^\circ\text{C}$  during 24, and gas production was accounted as the amount of water displaced by gas inside of each probet, and was expressed as mL of gas by g of feces DM basis. This procedure was repeated during four consecutive days. Results were analyzed by ANOVA for a complete randomized block design where day run constitutes the block. Fecal dry mater content was 26.9% and dose of tannin extract was equivalent to 7.45% DM basis. The addition tannins extract diminished ( $P < 0.001$ ) in 45% the in vitro gas production respect to Control treatment (8.92 vs. 16.24

mL/g of feces DM). It is concluded, that tannin extract addition could contributes to decreases gas production of feces from finishing beef cattle.

**Key Words:** feces, gas production, tannins

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**1522 (W233) Quantification of cephalosporin in dairy cow feces and urine using solid phase extraction (SPE) coupled with ultra performance liquid chromatography-tandem mass spectrometry (UPLC/MS/MS).**

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Antibiotic use in animal agriculture has been under scrutiny for two decades because of the persistency of excreted antibiotics in the environment and their potential contribution to bacterial antibiotic resistance. Cephalosporin, a cephalosporin antibiotic, is commonly used for dry cow therapy and other therapeutic treatments in dairy cows. Fecal and urinary excretion of cephalosporin could introduce this compound into the environment with land application of manure or runoff from the feedlot or barnyard. To date, however, the environmental loading of cephalosporin by the livestock industry remains un-assessed, largely due to a lack of appropriate analytical methods. Therefore, an analytical method was developed and validated to qualify and quantify cephalosporin in dairy cow feces and urine. The method includes extraction with phosphate buffer (0.05 M) and methanol at 50:50 (v/v) followed by solid-phase extraction (SPE) clean-up via elution through hydrophilic-lipophilic-balanced cartridges and filtering through 0.2- $\mu\text{m}$  filters. Cephalosporin in clarified sample extracts was qualified and quantified using ultra performance liquid chromatography-tandem mass spectrometry (UPLC/MS/MS). The limit of quantification (LOQ) of the developed method was 4.02 ng/g and 0.96 ng/mL for feces and urine, respectively. Recovery of cephalosporin from spiked blank feces and urine was 64 to 73% and 81 to 84%, respectively. Intra- and inter-day variation [residual standard deviation (RSD), %] were used to estimate repeatability and reproducibility of the method, and ranged from 7.9 to 8.2% for feces and 3.07 to 9.59% for urine. This method was applied to feces and urine collected from dairy cows within 8 h of cephalosporin administration. Trace amounts (ng/g) of the compound were detected in feces and very high concentrations (133 to 480 ng/mL) in urine. The described method is sensitive, accurate, and robust and will advance understanding of the fate and environmental impact of antibiotics used on farms.

**Key Words:** cephalosporin, dairy cow feces and urine, ultra performance liquid chromatography-tandem mass spectrometry



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**1523 (W234) Method development and application: Solid phase extraction (SPE) clean-up and ultra performance liquid chromatography-tandem mass spectrometry (UPLC/MS/MS) quantification of pirlimycin in dairy cow feces and urine.** P. P. Ray\*<sup>1</sup>, K. F. Knowlton<sup>2</sup>, C. Shang<sup>3</sup>, and K. Xia<sup>3</sup>, <sup>1</sup>*Dep. of Dairy Science, Virginia Polytechnic Institute and State University, Blacksburg,* <sup>2</sup>*Virginia Tech, Blacksburg,* <sup>3</sup>*Dep. of Crop and Soil Environmental Sciences, Virginia Polytechnic Institute and State University, Blacksburg.*

In the last two decades antibiotic excretion by livestock has received significant attention because of the contribution of excreted antibiotics to bacterial antibiotic resistance. Reliable and accurate quantification of antibiotics in feces and urine is critical to assess environmental loading of antibiotics by the livestock industry in the effort to maintain or improving the sustainability of animal agriculture. Pirlimycin, a lincosamide antibiotic, is one of the most commonly used antibiotics for the treatment of mastitis in dairy cows. There is no published data on pirlimycin loading to the environment via fecal and urinary excretion, probably due to inadequate methodology to quantify pirlimycin in fecal and urine matrices. Therefore, the objective of this study was to develop and validate an analytical method to quantify and quantify pirlimycin in dairy cow feces and urine. Samples were extracted with methanol+0.05 M phosphate buffer (70:30, v/v). Sample extracts were cleaned using solid phase extraction (SPE) via elution through hydrophilic-lipophilic-balanced (HLB) cartridges and filtering through 0.2- $\mu$ m filters. Clarified extracts were analyzed for pirlimycin using ultra performance liquid chromatography-tandem mass spectrometry (UPLC/MS/MS). This method was sensitive with a limit of quantification (LOQ) of 1.47 ng/g wet feces and 0.90 ng/mL urine. The developed method recovered 80 to 108% of pirlimycin spiked in feces and recovery was 89 to 98% in urine. Repeatability and reproducibility of the method was estimated by intra- and inter-day variations [residual standard deviation (RSD) %], and ranged from 2.3 to 13% and 2.3 to 14% for feces and urine, respectively. With the application of this method to samples collected in the 10 h following intramammary dosing, pirlimycin was detected at 61.2 to 71.8 ng/g and 153 to 254 ng/mL in feces and urine, respectively. This sensitive, accurate, and robust method can be used to quantify trace amounts of antibiotics in dairy cow feces and urine, and may help in the assessment of fate and environmental impact of antibiotics used on farms.

**Key Words:** pirlimycin, dairy cow feces and urine, ultra performance liquid chromatography-tandem mass spectrometry

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**1524 (W235) A larger proportion of grass feed components in the ration was associated with higher methane production rates of dairy cows.** C. C. Metges\*<sup>1</sup>, M. Derno<sup>1</sup>, J. Ziessler<sup>1</sup>, N. Krattenmacher<sup>2</sup>, G. Thaller<sup>3</sup>, and B. Kuhla<sup>1</sup>, <sup>1</sup>*Leibniz Institute for Farm Animal Biology (FBN), Dummerstorf, Germany,* <sup>2</sup>*Institute of Animal Breeding and Husbandry, Kiel University, Germany,* <sup>3</sup>*Christian-Albrechts-Universität, Kiel, Germany.*

Ruminants can utilize feedstuffs which are not in competition with human food. In 10 German Holstein cows, 4 in first (L1; BW 562 kg) and 6 in second (L2; BW 615 kg) lactation, 2 TMR rations fed ad lib were compared in regard to methane production. Ration 1 (R1) contained a mixture of grass silage, grass hay + straw (total of 22% DM), and corn silage (32% DM), and was fed to all cows from 20 to 103 DIM. Subsequently, from 104 to 140 DIM, cows received ration 2 (R2), comprising 41% DM of the grass silage, grass hay + straw mixture, and 18% DM of corn silage. Starch, fat and energy contents of R1 and R2 were 18, 4.5% DM, and 7.2 MJ NEL/kg, and 10, 2.7% DM, and 6.7 MJ NEL/kg, respectively. Water was offered ad lib. Appropriately acclimatized cows were measured in respiration chambers (see citation below) on 99 and 135 DIM for 36 h. The respective rations and water were provided ad lib. DMI, ECM yield, and methane production per d were determined. Data was analysed by PROC MIXED of SAS. DMI did not differ among rations and lactation number ( $P > 0.1$ ). However, ECM was lower with R2 (L1: 23.3. vs. L2: 29.2 kg/d) than with R1 (L1: 30.9 vs. L2: 36.3 kg/d) as well as in L1 than in L2 cows ( $P < 0.05$ ). Methane production was affected by ration but not by BW or lactation number with higher values in cows fed TMR with higher contents of grass components and lower proportions of corn silage (R2 vs. R1: 513 vs.455 L/d; 18 vs. 12 L/(kg ECM \* d); 39 vs. 34 L/(kg DM \* d);  $P < 0.05$ ). In conclusion, using larger amounts of feedstuffs less in competition with human food, i.e., grass and straw, contributes relatively more to greenhouse gas emissions. The lower ECM yield with R2 was partly due to progressing stage of lactation. Citation: Derno et al. J. Dairy Sci. 92:2804–2808, 2009.

**Key Words:** dairy cow, starch content, methane emission

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**1525 (W236) Effect of eco-saline system on some hematological and biochemical parameters in damascus goats raised under semi-arid conditions.** E. B. Abdalla\*, *Faculty of Agriculture, Ain Shams University, Cairo, Egypt.*

The effect of eco-saline system, composed of saline water and salt-tolerant plants, on hematological and biochemical responses of Damascus goats was investigated from August 2009 to June 2010. Forty-eight adult female Damascus goats were

equally assigned randomly into four groups. The first group (G1) fed berseem (*Trifolium alexandrinum*) hay (BH) and drank fresh water (247 ppm total dissolved solids), the second group (G2) fed BH hay and drank saline water (5980 ppm total dissolved solids), the third group (G3) fed salt-tolerant alfalfa (*Medicago sativa*) and drank fresh water and the fourth group (G4) fed alfalfa and drank saline water. Body weight changes, hematological and biochemical parameters were measured. Does of G1, G2, G3 and G4 gained 6.64, 8.2, 4.11 and 5.14 kg, respectively during gestation period. Feeding salt-tolerant plants and drinking saline water was negatively affected ( $P < 0.05$ ) hemoglobin (Hb), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) during different stages of pregnancy. However, packed cell volume (PCV %) and erythrocytes cell counts (RBCs) were not affected. Animals on saline water had significantly lower white blood cell counts than goats given fresh water. Values of WBCs increased with advancing pregnancy. Total protein (TP), albumin (A), globulin (G) and albumin/globulin ratio (A/G %) as well as alanine transferase (ALT) concentration of different groups were within the normal ranges reported for goats during different eco-saline systems. However, aspartate transferase was higher in salt tolerant groups. Except for phosphorus, serum minerals were higher in alfalfa groups. Concentrations of aldosterone of does fed salt-tolerant alfalfa were higher significantly than does fed berseem hay. It could be concluded that utilization of salt-tolerant plants as animal feeds in salt affected lands could be an appropriate option for alleviating the desertification problems and providing alternative feed resources, particularly in summer and autumn seasons when the other conventional forage resources are in short supply. Also, these results suggest that saline water can be used as a source of drinking water without any adverse effects on hematological and performance of Damascus goats.

**Key Words:** salt-tolerant plants, saline water, Damascus goats

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### 1526 (W237) Fibrolytic bacteria isolated from the rumen of North American moose (*Alces alces*).

S. L. Ishaq\* and A. D. G. Wright, *University of Vermont, Burlington.*

Fibrolytic bacteria were isolated from the rumen of North American moose (*Alces alces*), which eat a high-fiber diet of browse. It was hypothesized that fibrolytic bacteria isolated from the moose rumen could be candidates to improve fiber degradation and animal production. In vivo, an increase in cellulose degradation can increase weight gain, milk, and wool production. In industrial systems, digestion by microorganisms or enzymes can increase forage digestibility for livestock, improve ensiling, or provide glucose from biomass for bioethanol-production. Thirty-eight isolates were cultured from rumen digesta samples collected in October 2010 in Vermont. Using Sanger sequencing of the 16S rRNA gene, culturing techniques, and optical density, isolates were identified and screened for biochemical properties important to plant carbohydrate degradation. Isolates had the following percent identity to known sequences in NCBI: *Bacillus licheniformis*, 98- 100% ( $n = 22$ ); *Enterococcus faecalis*, 95- 99% ( $n = 6$ ); *Staphylococcus saprophyticus*, 99- 100% ( $n = 4$ ), *B. chandrigarhensis*, 98% ( $n = 1$ ); *B. firmus*, 98% ( $n = 1$ ); *B. flexus*, 100% ( $n = 1$ ); *B. niabensis*, 95% ( $n = 1$ ); *Enterobacter ludwigii*, 99% ( $n = 1$ ), and *Paenibacillus woosongensis*, 98% ( $n = 1$ ). Using a 97% identity cutoff for near full-length 16S rRNA gene sequences, there are 22 novel strains of *B. licheniformis*; one novel strain each of *B. chandrigarhensis*, *B. firmus*, and *B. flexus*; one novel species of *Bacillus*; three novel strains of *Enterococcus faecalis*, two novel *Enterococcus sp.*, one novel strain of *Enterobacter ludwigii*; one novel strain of *P. woosongensis*; and four novel strains of *S. saprophyticu*. Isolates were able to digest cellulose ( $n = 38$ ), cellobiose ( $n = 34$ ), xylan ( $n = 31$ ), starch ( $n = 25$ ), carboxymethylcellulose ( $n = 24$ ), and lignin ( $n = 20$ ) under minimal nutritional conditions. Fifteen isolates were able to digest all six carbohydrates tested. Isolates were able to tolerate up to 10% ( $n = 17$ ) salinity, between pH 4.0 ( $n = 34$ ) and pH 10.0 ( $n = 33$ ), and between 20°C ( $n = 35$ ) and 55°C ( $n = 36$ ). Isolates were tolerant to sodium azide ( $n = 37$ ), could reduce potassium tellurite ( $n = 3$ ), metabolize mannitol ( $n = 31$ ), produce indole from tryptophan ( $n = 7$ ), and all isolates could use citrate or propionate as a sole carbon source, as well as ammonium ions for nitrogen. New, highly efficient species or strains of fibrolytic bacteria could be utilized to improve fiber degradation in ruminants or in industrial applications. The isolates tested showed a wide range of carbohydrate digestion and were able to tolerate adverse growth conditions, making them good candidates for improved fiber digestion in vivo and suitable for high temperature industrial fiber digestion.

**Key Words:** fibrolytic, bacteria