PRODUCTION, MANAGEMENT, AND THE ENVIRONMENT: **MANAGEMENT AND HEAT STRESS**

1480 (T239) Concentrations of heavy metals in the whole raw milk of dairy cows under different management systems and country of origin: a meta-analytical study. G. Zwierzchowski and B. N. Ametaj*, *Dep. of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, Canada.*

The objective of this meta-analytical study was to investigate concentrations of toxic heavy metals including aluminium (Al), arsenic (As), cadmium (Cd), chromium (Cr), lead (Pb), nickel (Ni), and vanadium (Va) in whole raw bovine milk from different production systems (conventional vs. organic) and countries of origin. Data from 44 studies and 19 countries were used to create a dataset, which was used for statistical analyses. The average concentrations of Al, As, Cr, Va in the raw milk from the conventional system were greater (32.49, 0.27, 2.19, and 0.82, respectively) than those coming from ($P < 0.05$) organic farms (2.13, 0.14, 0.28, and 0.32 μmol/L, respectively). In addition, there were greater concentrations of Cd (0.25 μmol/L) and Pb (0.31 μmol/L) in the raw milk from conventional system vs. organic system (0.02 μmol/L and μmol/L 0.08, respectively) ($P < 0.05$). Lower amounts of Ni were reported for milk from conventional system (0.57 vs. 0.67 μmol/L; $P < 0.05$). Country of origin had significant effect on concentrations of toxic elements ($P < 0.05$). Turkey had greatest Al levels (283 μmol/L), whereas USA had the smallest means for this element (0.89 μmol/L) ($P < 0.05$). The lowermost concentrations of As were reported in Spain (0.01 μmol/L), whereas the greatest concentrations were found in Croatia (13.60 μmol/L) ($P < 0.05$). Average Cd level was 0.11 μmol/L; however, the greatest concentrations of Cd were reported in milk samples from Slovakia (6.49 μmol/L) ($P < 0.05$). In Nigeria concentrations of Cr in the milk were greater compared with other countries (38.04 μmol/L) ($P < 0.05$). Moreover, the greatest levels of lead (Pb) contamination were reported in milk samples from Egypt (4.63 μmol/L), whereas, the lowest means were observed in Poland (0.01 μmol/L) ($P < 0.05$). Regarding Ni, the lowest amounts were found in Brazil (0.03 μmol/L), whereas the greatest levels (50.25 μmol/L) were found in milk samples from Nigeria. Concentrations of Va varied from below 0.01 μmol/L (Spain) to 0.72 μmol/L (*P*oland). In conclusion, data from this meta-analytical study indicated that organic farms were characterized by lower concentrations of toxic heavy metals compared to the conventional system of management. This study also showed high variability in concentrations of heavy metals in raw milk with regards to the country of origin.

Key Words: whole raw milk, heavy metals, meta-analysis

1481 (T240) Macro- and microminerals in the whole raw milk of dairy cows from conventional and organic farms: A meta-analytical study. G. Zwierzchowski and B. N. Ametaj*, *Dep. of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, Canada.*

The objective of this meta-analytical study was to investigate selected macrominerals calcium (Ca), magnesium (Mg), phosphorous (P), potassium (K), and sodium (Na) and microminerals (copper (Cu), iodine (I), iron (Fe), manganese (Mn), selenium (Se), and zinc (Zn) in the bovine whole raw milk samples from two different management systems and 19 countries. An analytical dataset was constructed from 44 different studies and 19 countries with two types of production systems: conventional and organic. No differences in concentrations of Ca, Mg, and Na in the raw milk were observed when production systems were compared, whereas, concentrations of P and K were greater in the conventional production system ($P < 0.05$). The average concentrations of Cu, I, Fe, Mn, Se, and Zn in organic whole raw milk samples were 1.12, 1.77, 8.25, 0.47, 0.30, and 42.20 μmol/L respectively; and were lower ($P < 0.05$) compared with conventional milk (2.09, 2.37, 13.62, 1.97, 0.76, and 60.95 μmol/L respectively). The lowest concentrations of Cu (0.03 μmol/L), Se (0.17 μmol/L), and Zn (31.76 μmol/L) were reported in bovine raw milk samples from Italy, whereas Germany (Cu, 12.89 μmol/L) and Turkey (Se and zinc, 194.31, and 125.40 μmol/L respectively) had greater concentrations of those elements ($P < 0.05$). Raw milk samples from Polish and Czech dairy farms had greater concentrations of I (2.76 and 3.31 μmol/L respectively) compared to samples collected in Niger (0.17 μmol/L) and Germany (0.88 μmol/L). Iron levels varied from 3.47 μmol/L (USA) to 89.53 μmol/L (Pakistan) ($P < 0.05$). The lowest concentrations of Mn were observed in the milk samples from USA and Poland (0.38, and 0.48 μmol/L respectively), whereas the highest concentrations were reported in milk samples from China (5.89 μmol/L) and Republic of South Africa (3.62 μmol/L). In conclusion, data from this study indicate that concentrations of microelements in the samples of whole raw milk were lower in organic farms compared with the conventional production system. Moreover, milk samples originating from developed countries were characterized by normal concentrations of these minerals compared with other countries.

Key Words: whole raw milk, macro- and micro-minerals, production system

1482 (T241) Evaluating the accuracy of using reinforcing bar and an infrared thermometer versus long-stemmed thermometers in monitoring mortality compost pile temperature. E. Pacheco[1,2], A. Reyes[1,2], M. Negron[1,2], T. A. Gipson[2], and R. Merkel[*2], *[1]University of Puerto Rico, Mayaguez, [2]American Institute for Goat Research, Langston University, Langston, OK.*

Two mortality compost piles were constructed using a mixture of goat mortality and butcher waste with ground hay as the carbon source to compare core temperature recorded by long-stemmed thermometers (LST) vs. an infra-red thermometer (IR) to read temperature of a reinforcing bar (RB) thrust into the pile. One LST was inserted into the core of each pile along with a 3-m length of 0.95-cm-thick RB so that tips of both the RB and LST were in close proximity. For 30 d following pile construction, LST temperature was recorded daily between 1500 and 1600 h. Each RB was then withdrawn from the pile and the tip's temperature determined using an IR. Data were analyzed using repeated measures in a mixed model containing treatment (T = LST and RB), date as a covariate (D), and the interaction to test for heterogeneity of slope. Compost pile was a random effect. Date ($P < 0.001$) and T×D ($P < 0.001$) showed differences, whereas T was not significant ($P = 0.48$; 57.8 and 54.5°C for LST and RB, respectively, SE = 3.04). Date was used as a covariate as temperature in working mortality compost piles will spike soon after pile formation and slowly decline. As an example, LST recorded a temperature of 64.6°C on d 3 of data collection but only 50.4°C on d 30. The T×D test recorded a slope estimate of -0.320 for LST and -0.018 for RB (probability of slope > 0 of $P < 0.001$ and $P = 0.75$ for LST and RB, respectively). These results suggest that RB can be used to monitor mortality compost pile temperature but is not accurate enough to model the normal decline in temperature over time. Temperature of RB may have differed from LST due to location on reinsertion into the pile (cooler or hotter spot than LST tip) and alignment of IR on RB to record accurate RB temperature and not temperature of surrounding material. Using an IR with RB may be an acceptable method for monitoring mortality compost pile temperature and would be a cheaper alternative for producers composting multiple mortalities than to purchase LST for each pile. However, RB is not appropriate for use when precise temperature measurement is needed.

Key Words: goats, mortality compost, temperature

1483 (T242) Milk production, dry matter intake and body condition score evaluated in cross-bred commercial cows supplemented with OmniGen-AF during and following heat stress. A. E. Holland[1], J. D. Chapman[*1], and L. O. Ely[2], *[1]Prince Agri Products, Inc., Quincy, IL, [2]UGA, Athens, GA.*

Dairy cows in the United States are affected by heat stress for a significant part of the year, resulting in reduced dry matter intakes (DMI), milk yields (MY) and profits. In 2012, a 15-wk study (July 9 to October 16) was conducted in Texas to evaluate MY, DMI, and body condition score (BCS) in multiparous cross-bred (H x J) cows fed *OmniGen-AF* (OG) and subjected to heat stress. Two-hundred sixty-six early- to mid-lactation cows were enrolled based on parity, days in milk (DIM) and current MY and assigned to either the basal diet without OG (Controls, $n = 123$h) or basal diet plus OG ($n = 143$h). OG was fed at 56 g/h/d. The average parity and DIM for Controls and OG cows were 3.25, 134 d and 3.25, 130 d, respectively. Diets were fed as a TMR and orts collected daily to calculate DMI. Cows were housed in free-stalls with heat abatement and milked 3x/d. BCS was assessed at weeks 4, 10, and 15. Daily temperature (°C) was measured and weekly highs and lows calculated. Individual milk weights were retrieved from Westfalia Surge Dairy Plan System. Only cows with wk 1 and 15 milk weights and at least 12 total weekly weights were used. Data were analyzed using PROC GLM (SAS) and significance tested to $P < 0.05$. High and low average weekly temperatures (°C) for weeks 1 to 7 and 8 to 15 were 35.9, 21.8 and 25.9, 12.8, respectively. DMI did not differ between Controls or OG cows during wk 1 to 7 (26kg/d) or wk 8 to 15 (29.7kg/d). No differences in BCS were detected between Controls or OG cows at wk 4 (3.01), 10 (2.94) or 15 (2.75). Wk 1 to 7 MY's were not different between Controls (36.3kg/d) and OG cows (37.1kg/d); however, they differed ($P < 0.004$) in wk 8 to 15 (33.2kg/d; 35.5kg/d, respectively). OG cows MY averaged 1.3kg/d more ($P < 0.048$) than Controls from wk 1 to 15. MY's of Controls ($n = 43$h) and OG ($n = 51$h) cows that were 120 DIM or less at the start were not different in wk 1 to 7 (40.4kg/d; 42kg/d), however differed in wk 8 to 15 (36.5kg/d; 39.4kg/d, $P < 0.005$). Controls ($n = 80$h) and OG ($n = 79$h) cows 121 DIM or greater at the start were not different in MY, until wk 15 (28.8kg/d; 31.2kg/d, $P < 0.032$). All cows showed the typical MY and DMI response to heat stress; however, cows fed OmniGen-AF were observed to recover sooner as measured by milk production.

Key Words: heat stress, lactation, OmniGen-AF

1484 (T243) Factors affecting transition success in tie stall herds. D. E. Santschi[*1], M. S. Perreault[1,2], S. Adam[1], R. Lacroix[1], and D. M. Lefebvre[1], [1]*Valacta, Ste-Anne-de-Bellevue, QC, Canada,* [2]*Université Laval, QC, Canada.*

The transition period is the most critical time in the lactation cycle of a cow. It is generally accepted that a successful transition will have a positive impact on performances in the following lactation. Several years ago, Nordlund and collaborators have developped the Transition Cow Index (TCI): a tool to objectively evaluate transition. These authors have previously identified feedbunk space, number of group changes and size and comfort of rest area as the main factors affecting transition success in freestall herds. The aim of the present study was to identify factors that have an impact on transition success specifically in tie stall herds. Tie stall dairy herds (n = 48) from Québec, Canada, were selected based on their average TCI to have high and low TCI herds. Each herd was visited and producers were asked to complete a survey on their management decisions and practices (examples: number of place changes, number of daily feed push ups, boluses). In addition, several observations and measures (examples: stall dimensions, type and amount of bedding, lighting) were taken on each farm. Results suggest that nervousness of cows was the most important factor affecting transition success (calm vs. nervous cows, observed on the day of the visit; $P = 0.04$). Use of straw and woodshavings as bedding at any stage of the transition period significantly increased TCI ($P \leq 0.03$) whereas type of flooring (any type of mat vs. concrete) had no impact ($P \geq 0.15$). Providing a Rumensin bolus to dry cows tended to improve TCI ($P = 0.09$). Number of place changes during the transition period ($P = 0.09$) and number of times feed is pushed back ($P = 0.07$) tended to positively impact TCI. Stall dimension factors significantly correlated with TCI are reported in Table 1484.

Key Words: transition success, TCI, tie stall

Table 1484.

Factor	Corr. Coeff.	*P* value
Stall length far-off cows	0.35	0.02
Stall length precalving cows	0.40	< 0.01
Stall width precalving cows	0.32	0.03
Stall width fresh cows	0.32	0.02

1485 (T244) Effect of spatial orientation and shade on internal environment of a wooden 3-calf hutch. J. D. Allen[*1], and L. W. Hall[2], [1]*Northwest Missouri State, Maryville,* [2]*University of Arizona, Tucson.*

The objective of this study was to determine internal environments of California-style 3-calf hutches according to a combination of spatial orientation and shade. During mid-autumn at the University of Arizona's Campus Agricultural Center, Tucson, 8 California-style (3 cubicles/hutch) were designated to 1 of 2 treatments: exposure to direct sunlight (DS) or placement underneath a drylot shade structure (NDS). Hutches within each group were oriented to 1 of 4 directions: north, south, east, and west. Hutches were equipped with 6 temperature/relative humidity data loggers (two loggers/cubicle) evenly placed at 41 cm above the slatted wood flooring and 41 cm from the sides of the cubicle. For 4 d, each hutch was rotated clockwise once every 24-h period and before daylight hours so that each hutch was exposed to all 4 directions at least once. Ambient condition data were analyzed as a complete randomized block design with hutch as the experimental unit. Overall, DS hutches had a greater average temperature-humidity index (THI) (62.7 vs. 61.5 ± 0.17; $P < 0.01$) compared to NDS hutches. However, DS hutches had greater 24-h range ($P < 0.01$) for THI (56.1–69.2 vs. 57.4–65.7 ± 0.19), ambient temperature (26.3–13.4 vs. 22.5–14.6 ± 0.18°C), and relative humidity (24.8–42.3 vs. 27.5–39.9 ± 0.37%) compared to NDS hutches. A 24-h THI range of 60.5 (north-facing NDS) to 63.6 (east-facing DS) with a temperature range of 17.7 (north-facing DS) to 20.6°C (east-facing DS) was observed. Highest THI ($P < 0.01$) was recorded for all treatments except west-facing NDS during 1200 to 1800 h (THI > 70) compared to other 6-h periods (0000 to 0600, 0600 to 1200, 1800 to 0000 h). South-facing DS hutches recorded the greatest THI range (51.5 to 75.7; $P < 0.01$), while west-facing NDS hutches had the least THI range (57.3 to 64.5; $P < 0.01$). Grid mapping of daytime and nighttime THI for each treatment showed THI uniformity within each hutch was dependent on both orientation and shade. Results indicate shaded wooden three-calf hutches are kept at a cooler and less variable environment compared to unshaded hutches during a mid-autumn, southwestern climate. Also, a 13-point THI difference during a 24-h period can be observed within a hutch exposed to direct sunlight.

Key Words: calf hutch, internal environment, spatial orientation

1486 (T245) Effect of deterred and undeterred bird depredation on nutrient composition of a cattle diet and growth performance in cattle at a Southwestern feedlot facility. J. D. Allen[*1], L. W. Hall[2], S. Garcia[2], and J. Marchello[2], [1]*Northwest Missouri State, Maryville,* [2]*University of Arizona, Tucson.*

A summer study was performed to determine the effect of bird depredation on nutrient composition of a diet fed to and performance parameters of feedlot cattle with open or limited exposure to depredating birds at the University of Arizona West Agriculture Campus (Tucson). This study also investigated feeding preference of individual feedstuffs used at the feedlot. Feeder cattle (n = 50; 170 ± 15 kg) were sorted by gender then randomly assigned to 1 of 8 pens assigned to 1 of 2 treatments: open feed trough exposure to the existing bird

population (OP) or limited feed trough exposure to the bird population utilizing self-closing wire gates (LM). Cattle were fed until backfat ultrasound measurement reached 1cm (476.5 ± 2.8 kg). Diets were sampled at 0, 7, and 24 h post-feeding and analyzed for DM, NDF, ADF, CP, ash, and starch. Cattle performance parameters included G:F ratio, ADG, cost per kg of gain, and final BW. On separate days, DM disappearance was recorded for either individual feedstuffs included in cattle diet or grains varying in processing level placed in troughs not exposed to cattle. Cattle and feed data were analyzed as a complete randomized design with pen as the experimental unit. Both CP and ADF were greater ($P < 0.02$) in OP versus LM troughs at 7 and 24 h, although starch was greater ($P < 0.02$) in LM versus OP troughs after 24 h. Although LM and OP cattle had equivalent ADG, LM cattle had greater G:F ratio ($P < 0.02$), lower cost per kg gain ($P < 0.05$), and tended ($P < 0.10$) to have lower final BW when compared to OP cattle. Dry matter disappearance for diet feedstuffs was greatest ($P < 0.01$) for steam-flaked corn, followed by SBM, mineral mix, alfalfa, and urea, respectively. DM disappearance for grain type was greatest ($P < 0.01$) for whole milo, followed by rolled corn, steam-flaked corn, ground milo, ground barley, ground corn, and whole corn and whole barley, respectively. Birds feeding in the trough included pigeon (*Columbia livia*), mourning dove (*Zenaidura macroura*), and Eurasian dove (*Streptopelia decaocto*). Results indicate that bird populations present at Southwestern cattle feeding operations are capable of altering production parameters in cattle as well as altering nutrient composition in feed through feedstuff preference.

Key Words: bird depredation, cattle, nutrient loss

1487 (T246) Predicting Holstein heifer growth by genomic traits.

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Assessment of heifer weights and ADG is a recommended practice for managing dairy heifers, however the genetic variance of mature animal size obfuscates the meaning of a limited number of measured weights and ADG on a commercial dairy. The objective of this study was to use type traits and PTA milk from the heifer's first genomic test to predict the 24-mo body weight. This would allow an adjusted growth curve to be applied to heifers individually and management decisions made on the animal's current body weight status or deviation or both from its genetic potential. A database of heifers ($n = 802$, genotyped $n = 561$) and their body weights ($n = 2373$, ranging from 4 mo of age to 26 mo) was used in this study. An exponential model for heifer growth by age was made for all body weights, to fix the shape of the growth curve. A nonlinear regression was then fitted using the exponential model and the individual animal's measurements to solve for the model coefficient, setting the amplitude of the growth curve by animal. This resultant coefficient was regressed against the animal's PTA milk and type traits, using a criteria of $P > 0.20$ for removal of variables. The resultant regression equation ($R^2 = 0.12$) consisted of terms: PTA milk, final score, stature, body depth, rear leg side and rear view, udder height, udder depth, front and rear teat placement, and teat length. Using the genomic model by animal the mean square error for the growth model was reduced from 4937 to 4451. The present model, based on genomic body traits, did not yield the desired level of body size prediction to be utilized as an on-farm heifer assessment tool.

Key Words: heifer, growth, management

1488 (T247) Blood parameters in transition dairy cattle and their effects on milk production.

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Circulating metabolites nonesterified fatty acids (NEFA), β-hydroxybutyrate (BHBA) and cholesterol are commonly used as parameters of negative energy balance (NEB) or ketosis in dairy cows, whereas concentrations of aspartate aminotransferase (AST) indicate the occurrence of hepatic lipidosis. The objective of this study was to evaluate the effects of blood parameters on milk production in pre and postpartum Holstein cows. Blood samples were collected from 197 animals in the prepartum (-14 to -1 d) and 285 animals postpartum (+1 to +14 d) from 30 herds of Parana State, Southern Brazil. At each visit, a sample of 10 mL of blood was collected from the coccygeal vessels into sterile tubes without anticoagulant and kept refrigerated until analysis. After collection, blood samples were centrifuged and the serum was analyzed in an automatic biochemical analyzer using commercial kits for NEFA, BHBA, AST and cholesterol parameters. Milk production was assessed using mature-equivalent 305-d (ME305) milk yield estimated at 100 d in milk. While controlling for body condition score (BCS) and parity, the effects of elevated NEFA, BHBA, and cholesterol concentrations on ME305 milk yield were estimated, with herd as a random effect. The mean values for the prepartum were 0.23 ± 0.21 mmol/L NEFA; 0.46 ± 0.27 mmol/L BHBA; 57.48 ± 16.34 U/L AST; and 84.00 ± 19.14 mg/dL cholesterol. In cows and heifers, ME305 milk yield was decreased ($P < 0.05$) by 760 kg when prepartum NEFA concentrations were ≥ 0.33 mEq/L. The mean values in the postpartum group were 0.53 ± 0.40 mmol/L NEFA; 0.64 ± 0.44 mmol/L BHBA; 85.17 ± 31.50 U/L AST; and 84.35 ± 23.45 mg/dL cholesterol. In this postpartum group, NEFA and BHBA were ($r = 0.49$; $P < 0.01$) correlated among themselves and with AST ($r = 0.31$ and $r = 0.27$, respectively; $P < 0.01$). In all animals sampled postpartum, ME305 milk yield

was increased ($P < 0.05$) by 852 kg when BHBA concentrations were $\geq$ 0.97 mmol/L. In primiparous and multiparous sampled postpartum, ME305 milk yield was increased by 492 and 1376 kg on hypercholesterolemic animals (> 120 mg/dL), compared with normocholesterolemic (between 80 and 120 mg/dL) and hypocholesterolemic animals (< 80 mg/dL), respectively. In cows sampled postpartum, ME305 milk yield was decreased ($P < 0.05$) by 793 kg when NEFA concentrations were $\geq$ 0.72 mEq/L. This study suggests that increased concentrations of NEFA and lower concentrations of cholesterol and BHBA had detrimental effects on milk production.

Key Words: β-hydroxybutyrate, cholesterol, nonesterified fatty acids

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1489 (T248) A comparison of two implant protocols: Synovex-Choice and Synovex-Plus vs. Synovex-S and Revalor-S on steer feedlot performance and carcass characteristics. H. R. Nielson*[1], A. F. Summers[2], and R. N. Funston[1], [1]*University of Nebraska, West Central Research and Extension Center, North Platte,* [2]*University of Nebraska, Lincoln.*

An experiment was conducted to determine the impact of two implant protocols on steer feedlot performance and carcass characteristics. Over a 2-yr period, 109 crossbred (5/8 Red Angus, 3/8 Continental) steers were randomly assigned to 1 of 2 implant protocols; 1) Synovex-Choice [100 mg of trenbolone acetate (TBA) and 14 mg of estradiol benzoate (EB)] implanted at the beginning of the feeding period (CHPL); or 2) Synovex-S (200 mg of progesterone and 20 mg of EB; SS) as initial implant. Steers were fed for approximately 100 d, and the CHPL treatment was re-implanted with Synovex-Plus (200 mg of TBA and 28 mg of EB) while the SS treatment received Revalor-S (120 mg of TBA and 24 mg of estradiol). At 205 d on feed, steers were shipped to a commercial abattoir for slaughter. Carcass characteristics were evaluated 24 h following slaughter; HCW was determined on d of harvest. Average daily gain was similar ($P = 0.39$) for CHPL (1.75 ± 0.08 kg/d) and SS (1.70 ± 0.08 kg/d) steers. There was no difference ($P = 0.37$) in HCW for CHPL compared with SS steers (380 ± 7 vs. 374 ± 7 kg, respectively). Yield grade was also not affected ($P = 0.16$) by treatment, 2.5 and 2.7 ± 0.3 for CHPL and SS, respectively. There was no difference in LM area ($P = 0.98$) between CHPL and SS (90.52 vs. 90.52 ± 2.26 cm^2), and back fat was also similar ($P = 0.13$) between the treatments (1.37 vs. 1.50 ± 0.15 cm, CHPL vs. SS, respectively). Marbling score was similar ($P = 0.19$) between treatments (501 vs. 525 ± 13, CHPL and SS, respectively) resulting in a similar percentage of steers grading USDA Choice [CHPL vs. SS, 93 ± 3% vs. 96 ± 3% ($P = 0.42$)] and upper 2/3 USDA Choice [CHPL vs. SS; 47 ± 7% vs. 54 ± 7% ($P = 0.51$)]. Net revenue was similar ($P = 0.36$) between CHPL ($1083.11 ± 37.83) and SS ($1103.43 ± 37.83) steers. Both implant regimens utilized in the current study resulted in similar feedlot and carcass characteristics.

Key Words: carcass characteristics, feedlot performance, implants

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1490 (T249) Mitigating heat stress in dairy cattle via conductive cooling. K. M. Perano*, K. G. Gebremedhim, J. G. Usack, T. J. Shelford, C. A. Gooch, and L. T. Angenent, *Cornell University, Ithaca, NY.*

The U.S. dairy industry, a $37 billion-per-year industry (2012), loses more than $1.5 billion in a typical year to the effects of heat stress on lactating dairy cattle. High ambient temperature or humidity leads to cows having trouble disposing of metabolic heat, causing an increase in respiration rates and body temperature along with a decrease in milk production. Our objective was to design, build, and test a conductive cooling system for relieving heat stress in lactating dairy cattle. Our study used eight first-lactation Holstein cows producing 34.4 ± 3.7 kg/d of milk at 166 ± 28 d in milk. Cows were milked twice per d at 0600 and 1800 h. Cows were exposed to heat stress in a climate-controlled room from 0930 until 1730 h daily but moved to well-ventilated pens at night. During the time the heat stress occurred, each of the four experimental cows was conductively cooled by pumping chilled water through a waterbed in her stall, but the four control cows were given no heat stress relief. The cooling system was tested at two different heat stress levels (THI = 81.3 ± 0.7 and THI = 79.7 ± 0.8) as well as two different chilled water temperatures (4.5°C and 10°C) for a total of four treatments. Each treatment lasted for 7 d. Milk production, feed consumption, and rectal temperature were recorded twice daily. Respiration rates and skin temperatures were measured five times per day. Data loggers recorded the cooling water temperature, the ambient temperature and humidity, and the vaginal temperature as well as standing and lying behavior of each cow. Results from the higher heat stress/lower water temperature treatment show that conductive cooling removed ~850 Watts (about 60% of the total metabolic heat from a lactating Holstein cow) whenever the cow was lying down. This significantly reduced the effects of the heat stress, with cooled cows producing 35.5 ± 2.0 kg/d of milk while control cows produced 26.2 ± 4.7 kg/d of milk ($P = 0.024$). Rectal temperatures for cooled cows were 39.2 ± 0.6°C while control cows were 40.3 ± 0.6°C ($P = 0.039$). Respiration rates were 64 ± 10 breaths/min for cooled cows compared to 84 ± 10 for control cows ($P = 0.033$). Such results indicate that conductive cooling shows promise for mitigating heat stress in lactating dairy cattle.

Key Words: conductive cooling, heat stress, milk production

1491 (T250) Changes in behavioral and physiological parameters around estrus in partially synchronized cows. K. A. Dolecheck*, W. J. Silvia, G. Heersche Jr., A. E. Sterrett, B. A. Wadsworth, and J. M. Bewley, *University of Kentucky, Lexington.*

The objective of this study was to compare estrus detection potential of cow behavioral and physiological parameters collected by multiple precision dairy farming technologies. Technologies included the SensOor (Agis Automatisering, Harmelen, Netherlands), DVM bolus (DVM Systems, LLC, Greeley, CO), HR Tag (SCR Engineers Ltd., Netanya, Israel), IceQube (IceRobotics Ltd., Edinburgh, Scotland), and Track a Cow (Animart Inc., Beaver Dam, WI, and ENGS, Rosh Pina, Israel). Ovulation was synchronized for 35 cows in three groups between January and June 2013 at the University of Kentucky Coldstream Dairy using a modified G7G/Ovsynch ending after the last $PGF_{2\alpha}$ injection (Day 0) to allow estrus expression. Visual observation of cows for four 30-min periods at 0330, 1000, 0230, and 2200 h on d 2, 3, 4, and 5 confirmed estrus by recording when cows stood to be mounted. Eighteen of the 35 cows stood to be mounted at least once during the observation period and were used for analysis. The GLM procedure of SAS (SAS Institute, Inc., Cary, NC) was used to compare differences between the 24-h period surrounding the standing event (estrus) and the week preceding that period (non-estrus) for all technology parameters. Significant differences ($P < 0.05$) between estrus and non-estrus were observed for the following parameters (reported as estrus vs. non-estrus ± SE): SensOor minutes ruminating/h (16.02 vs. 22.68 ± 0.84), SensOor minutes feeding/h (14.48 vs. 8.86 ± 0.94), SensOor minutes of high activity/h (13.66 vs. 4.18 ± 0.79), HR Tag minutes ruminating/2 h (22.30 vs. 28.67 ± 1.40), HR Tag activity units/2 h (49.10 vs. 26.74 ± 2.19), IceQube lying bouts/h (0.47 vs. 0.70 ± 0.06), IceQube total motion units/h (912.38 vs. 316.82 ± 59.82), IceQube steps/h (224.41 vs. 84.53 ± 14.09), IceQube minutes lying/h (16.35 vs. 24.12 ± 1.19), and Track a Cow activity units/h (197.07 vs. 78.19 ± 26.29). No significant differences between estrus and non-estrus were observed for SensOor mean temperature/h, DVM bolus twice-daily temperature, and Track a Cow lying percent/h. This data demonstrates that multiple measureable parameters may be useful for detecting estrus events.

Key Words: precision dairy farming technologies, estrus detection

1492 (T251) Effect of maternal heat stress during the dry period on development of immune system of offspring. B. M. Ahmed[*1], A. P. A. Monteiro[1], S. Tao[1], K. E. Merriman[2], J. P. Driver[2], B. L. Artiaga[1], J. Hayen[1], I. M. Thompson[1], C. D. Nelson[2], and G. E. Dahl[1], *[1]University of Florida, Gainesville, [2]Dep. of Animal Sciences, University of Florida, Gainesville.*

Maternal heat stress during the dry period affects calf immune response during postnatal life, but it is still unknown how in utero heat stress affects calf's immune system development. The objective was to evaluate the effects of in utero heat stress on distribution of different immune cell types in blood and primary and secondary lymphoid tissues of the calf. Cows were dried off 60 d before expected calving and randomly assigned to one of two treatments: heat stress (HT) or cooling (CL). During the dry period, all cows were housed in a freestall barn with fans over the feed line and stalls, but only the feeding area for CL cows was equipped with soakers. Heat stress was moderate compared with other studies, as HT cows had only 0.1°C increase in rectal temperature and 8 breath/min increase in respiration rate compared with CL cows. Immediately after birth, singleton calves (HT: $n = 200$; CL: $n = 188$) were weighted and then fed 3.8 L of colostrum (score: bull < 80; heifer > 80) within 1 h after birth. Blood samples were collected from a subset of heifers (HT: $n = 12$; CL: $n = 10$) at birth before colostrum feeding, d 3, 28, and 56 of age to evaluate the proportion of blood T and B lymphocytes, granulocytes, monocytes, and γδ-T cells by flow cytometry. Additionally, a subset of bull calves (5/treatment/day) were randomly selected and slaughtered at birth (without colostrum feeding), 1 and 2 d after birth. Thymus and spleen were weighed and then a sample was excised, homogenized and assayed using flow cytometry to determine the proportion of different immune cell types. No difference was observed between treatments for calf birth weight (CL: 41.0; HT: 40.6 kg; $P = 0.32$). However, the thymus of CL bull was proportionally heavier (0.18 vs. 0.14% of body weight, respectively; $P < 0.05$) compared with HT calves. Preliminary analyses indicate that treatments had no impact on the proportion of different immune cells of calf blood during the preweaning period. Thus, we conclude that the slight difference in heat strain on HT and CL cow during the dry period has no significant impact on general fetal growth during the dry period and blood immune cell profile during the preweaning period in current study; however, it seems that late gestation maternal heat stress influences fetal primary lymphoid tissue development.

Key Words: heat stress, dry period, dairy calf

1493 (T252) Impact of dry period heat stress on milk yield, reproductive performance and health of dairy cows. I. M. Thompson*, A. P. A. Monteiro, G. E. Dahl, S. Tao, and B. M. Ahmed, *University of Florida, Gainesville.*

Two studies were performed to determine the effects of heat stress during the dry period on subsequent lactation yield, occurrence of health disorders, and reproductive performance. In experiment 1, cows were dried off 60 d before calving and assigned to cooling (CL, n = 250) or heat stress (HT, n = 250). CL cows were housed with sprinklers, fans and shade, whereas the HT group had fans and shade. All cows were cooled postpartum. Rectal temperature (RT) and respiration rate (RR) were recorded during the dry period. BCS was recorded weekly during the dry period and at d 7 and 33 postpartum. Milk yield was recorded monthly. Occurrence of postpartum disorders was evaluated during the first 60 DIM. Reproductive performance included metritis check (MC), days to first breeding (DTAI) and pregnancy rates. In experiment 2, records of 147 multiparous cows over 5 yr that were under cooling (n = 73) or heat stress (n = 74) during the dry period were analyzed. In those studies, HT cows did not have fans or soakers. Traits analyzed were 305 d milk production, number of breedings, and occurrence of postpartum health disorders. In experiment 1, relative to HT, CL cows had lower RT (39.0 vs. 39.1°C; P = 0.03) and RR (51 vs. 59 breath/min; P < 0.01) when dry. BCS during the dry period and postpartum, DTAI and MC33 did not differ between treatments. CL cows tended to have a greater incidence of metritis at d 7, but no other differences in postpartum health disorders were observed. Milk yield for the first 2 mo of lactation did not differ. In experiment 2, HT cows had higher RT (39.0 vs. 39.4°C; P < 0.001) and RR (48 vs. 76 breath/min; P = 0.02) than CL cows. Additionally, CL cows produced 5.3 kg/d more milk (P = 0.01) than HT cows. BW and BCS after calving did not differ between treatments, but CL cows gained more BW and increased BCS during the dry period versus HT cows. Reproductive performance did not differ between treatments. CL cows had a higher incidence of ketosis, and tended to have a higher incidence of metritis and retained placenta versus HT cows. Cooling dry cows during the dry period improves subsequent lactation performance, but the severity of heat stress is a significant influence on the response.

Key Words: heat stress, dry period, lactation

1494 (T253) Extending the interval from Presynch to initiation of Ovsynch in a Presynch-Ovsynch protocol did not reduce fertility of lactating dairy cows not detected in estrus that received timed artificial insemination. J. O. Giordano[*1], M. J. Thomas[2], G. K. Catucuamba[2], and M. D. Curler[2], [1]*Dep. of Animal Science, Cornell University, Ithaca, NY,* [2]*Dairy Health and Management Services, LLC, Lowville, NY.*

Our objective was to determine if extending the interval from Presynch to initiation of Ovsynch by 2 d (from 12 to 14) in a Presynch-Ovsynch protocol would reduce pregnancies per AI (P/AI) for cows not detected in estrus that receive timed AI (TAI). Lactating dairy cows (n = 1817) from four commercial farms in New York (Farm A = 218, B = 1031, C = 258, and D = 310) were enrolled in the Presynch-Ovsynch protocol to receive TAI at 73 ± 3 DIM. Cows were blocked by parity and randomly assigned to two groups: PS12 (n = 909; PGF-14d-PGF-12d-Ovsynch-56) or PS14 (n = 908; PGF-14d-PGF-14d-Ovsynch-56). Timed AI was performed approximately 16 h after GnRH. Cows detected in estrus at any time from the second PGF injection of Presynch until the day before TAI were inseminated. Pregnancy was assessed at 39 ± 3 d after AI using transrectal ultrasound. The percentage of cows receiving TAI was greater (P < 0.001) for PS14 than PS12 (55.2 vs. 48.5% respectively), was greater (P < 0.001) for farm D (70.7%) than A (60.1%) and C (57.8%) whereas farm B (43.0%) had the lowest percentage of cows receiving TAI. More (P < 0.001) multiparous (58.4%; 661/1131) than primiparous (41.0%; 281/686) cows received TAI. There was no treatment by farm interaction (P = 0.74) or treatment by parity interaction (P = 0.96) for the percentage of cows receiving TAI. Pregnancies per AI for cows receiving AI after detection of estrus was similar (P = 0.41) for PS12 and PS14 (34.6 vs. 37.4% respectively), was not affected (P = 0.44) by farm, and was similar (P = 0.36) for primiparous and multiparous cows (37.5 vs. 34.5% respectively). Pregnancies per AI for cows receiving TAI after completing the Presynch-Ovsynch protocol were similar (P = 0.98) for PS12 and PS14 [35.4 (156/441) vs. 35.5% (178/501), respectively], tended to differ by farm (P = 0.10), and were similar (P = 0.50) for primiparous and multiparous cows (37.1 vs. 34.8% respectively). Also, there was no treatment by farm (P = 0.91) or treatment by parity interaction (P = 0.34) for P/AI after TAI. Thus, extending the interval from the second PGF injection of Presynch to the initiation of the Ovsynch protocol by 2 d (from 12 to 14 d) did not reduce fertility of lactating dairy cows that were not detected in estrus and completed Presynch-Ovsynch to receive TAI.

Key Words: Presynch-Ovsynch, timed AI, dairy cow

1495 (T254) Mortality and herd turnover rates in large dairy herds in the upper Midwest United States. T. Evink*, and M. I. Endres, *University of Minnesota, St. Paul.*

The objectives of this study were to describe mortality and herd turnover rates in large Upper Midwest dairy herds, and evaluate the association between breed and mortality rates. The study included 15 dairy farms in Minnesota, Wisconsin, Iowa, and South Dakota. All farms had over 2500 lactating cows housed in a freestall system. Twelve of the farms had Holstein cows, two farms had Jersey cows, and one farm had Jersey and Holstein crosses. Herd size (mean ± SD) was 4972 ± 2652 cows with a range of 2600 to 13,250 cows. On farm records were obtained for 2 yr on each farm from July 2011 to July 2013. Sold and died events were examined from the on farm record keeping system to determine mortality and herd turnover rates. Herd turnover rate was calculated as the number of animals that were sold or died during a 1-yr period, divided by the average herd size during that 1-yr period. Mortality rate was calculated as the number of animals that died during a 1-yr period, divided by the average herd size during that period. Overall mortality rate was 7.4 ± 2.1%. Deaths on farm were categorized as injury, mastitis, lameness, sickness, down cow, transition diseases, dystocia, euthanasia, miscellaneous, or unknown reasons. Main causes of death were sickness (33.5 ± 17.3), unknown reasons (15.3 ± 24.6), and injury (11.1 ± 10.6). Overall herd turnover rate was 41.6 ± 5.9%. Reasons for turnover were categorized as low production, lameness or injury, mastitis, reproduction, transition problems, abortion, udder conformation, sickness, miscellaneous, or unknown reasons. Main reasons for turnover were low production (30.0 ± 22.0), mastitis (16.4 ± 11.9), and sickness (12.7 ± 5.2). Turnover rate during the first 60 DIM was 8.3 ± 2.3%. The PROC MIXED in SAS was used to evaluate the association between mortality rate and breed (Jersey vs. Holstein). Breed was associated with yearly mortality rate (P = 0.038); mortality rates (LSMeans ± SE) were 5.3 ± 0.01 and 7.6 ± 0.003 for Jersey and Holstein herds, respectively. Mortality rate in the first 60 DIM was 3.1 ± 0.003 for Holstein and 2.2 ± 0.01 for Jersey herds and there was no association with breed. Based on these results, Jersey cows appear to have lower overall mortality rates but similar early lactation mortality rates compared to Holstein cows in large freestall herds.

Key Words: mortality rate, turnover rate, large dairy herd

1496 (T255) Biased milk production programmed by fetal sex affects sexed semen economics. A. De Vries*[1], K. Hinde[2], A. J. Carpenter[3], J. Clay[4], and B. Bradford[3], [1]*University of Florida, Gainesville,* [2]*Harvard University, Cambridge, MA,* [3]*Kansas State University, Manhattan,* [4]*Dairy Records Management Systems, Raleigh, NC.*

Recent research has shown that Holstein dairy cows produce more milk per lactation after giving birth to female calves and when gestating female calves compared to male calves. The objective of this study was to evaluate how the economics of the use of sexed semen are affected by these differences in milk production. A herd budget simulation program was used that included separate daily cash flow projections for heifers and at least 4 parities of cows. Cash flows were based on lactation curves, feed intakes, reproductive parameters, culling and prices for milk, feed, calves, cull cows, semen, among other inputs. Based on the recent research, a first parity cow produced 185 kg per lactation more milk when she had given birth to a female calf and was gestating a female calf compared to giving birth to and gestating a male calf. A second parity cow produced 269 kg per lactation more milk when she had given birth to female calves in the current and first parity. Third and greater parity cows produced 100 kg more milk when giving birth to a female compared to a male. Other combinations of males and females resulted in smaller effects. Compared to conventional semen, sexed semen reduced the probability of conception by 20% and was $15 more expensive. Female calves were $100 more valuable than male calves. Cow pregnancy rates were 21% without sexed semen. Five sexed semen scenarios were evaluated, ranging from 1x sexed semen in heifers to 3x in heifers and 2x in first parity cows. Sexed semen break-even prices ranged from $3 to-$2 without the effects of fetal sex on milk production, compared to no use of sexed semen. Including the effects of fetal sex on milk production, sexed semen break-even prices ranged from $15 to $4. Break-even female calf prices, compared to male calf prices, were up to $29 lower when including the effects of fetal sex on milk production than when ignoring these effects. In conclusion, the effects of fetal sex on milk production make the use of sexed semen more economically feasible and should be included in economic calculations.

Key Words: fetal sex, milk production, sexed semen, economics

1497 (T256) Study the temperature-humidity index and its effect on performance of dairy cows in Isfahan. G. Ghorbani*, and A. Ahangaran, *Isfahan University of Technology, Iran.*

A temperature-humidity index (THI) is a single value representing the combined effects of air temperature and humidity associated with the level of heat stress. The objective of

this study was to evaluate the effects of THI on milk yield and milk composition of dairy cows in climatic conditions of seven Isfahan dairy farms. The experiment performed during in July 2012 to October 2013. In this study, eight THI with different weightings of dry bulb temperature and humidity were compared. Ambient temperature and relative humidity were measured every 15 min with data loggers located throughout the farm. According to THI values, from mid-October to early May the heat stress was lower than the threshold, with lowest values in January. Then THI was higher than threshold until mid-October, which was the highest level in July. Indices with higher weightings of humidity are more appropriate for humid climates, and indices with the most emphasis on ambient temperature are more suitable for semiarid climates. Since that Isfahan is located in the dry climate, THI 5 is the best indicator of its eight temperature–humidity indicators. The threshold for heat stress was 65 by THI 5. When THI increased one unit upper than treshold, average milk production decreased 0.5 Kg. Disintegration of estimated THI thresholds of heat stress into corresponding temperature and relative humidity revealed that heat stress occurred in Isfahan at temperatures $\geq$ 21°C and relative humidity of 25%. Results clearly showed a negative relationship between milk production and THI. Indeed, as THI increases from 49.1 in the winter season to 70.8 in the summer season, heat stress reduced total milk production by 38.5 to 36.1 kg, respectively. This decrease can be largely explained by the effect of summer heat stress, particularly in July, August and September when THI values are well above the critical threshold of 65. The reason for the drop in milk yield during the early fall could be explained by the carry over effect of the unfavorable conditions during the summer particularly in the absence of environmental control systems.

Key Words: temperature-humidity index, heat stress, milk loss

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1498 (T257) The influence of body weight on the efficiency of dairy cows. P. L. Kunz*, and A. Reinhard, *Bern University of Applied Sciences, Zollikofen, Switzerland.*

Questions about the efficiency of dairy cows are a consequence of the increasing pressure on milk prices. Efficiency is defined as the relationship between energy output (milk energy) and energy input (feed energy). For methodological reasons, it is often only the energy output (milk) which is assessed, ignoring the energy input (feed energy). As a result, research into the efficiency of dairy cows has so far shown uneven results. The aim of this study was to calculate efficiency by measuring the effective daily energy intake and energy expenditure in milk, and to investigate whether the body weight of cows had an influence on their efficiency. Efficiency was defined as: efficiency = (milk energy (MJ)/net energy intake (MJ NEL). Data were collected from the Holstein Frisian and Brown Swiss dairy cows at the research centre of the Swiss Federal Institute of Technology (Zurich). Throughout lactation and the subsequent dry period, the cows were weighed daily. The quantity of milk produced was recorded twice daily and the milk ingredients measured monthly. Feed samples of all ration components were taken every month and analysed. Using scales installed under each feed trough, the feed intake of individual cows was measured continuously during the whole lactation. In this way, the daily energy intake and the daily energy output in milk could be quantified. Data from 450 lactations of 158 cows were collected. After eliminating incomplete datasets, 105 lactations of 65 cows (40 Holstein Frisian and 25 Brown Swiss cows) were submitted to statistical analysis. The results show that the body weight of cows with two or more lactations positively correlated with both daily feed intake ($P = 0.018$) and milk yield ($P = 0.022$). This means that an additional 100 kg body weight required 2.0 kg DM/day more feed intake and yielded 630 kg more milk per lactation. However, there was no significant correlation between body weight and efficiency ($P = 0.39$), not even after dividing the samples by breed and lactation numbers. In this sample, heavy cows were equally efficient as light cows, compensating for their increased maintenance requirement by higher feed intake and higher milk yield. The differences in efficiency between individual cows must therefore be explained by other factors.

Key Words: dairy cow efficiency

1499 (T258) Effects of supplementation with propylene glycol in heat-stressed dairy goats. S. Hamzaoui[1], A. Salama[*1,2], G. Caja[1], E. Albanell[1], and X. Such[1], *[1]Group of Ruminant Research (G2R), Universitat Autonoma de Barcelona, Bellaterra, Spain, [2]Animal Production Research Institute, Dokki, Giza, Egypt.*

We hypothesized that supplementation with propylene glycol would increase blood glucose and spare amino acids for milk protein synthesis rather than glucose production. To test this hypothesis, we used eight multiparous Murciano-Granadina dairy goats (40.8 ± 1.1 kg BW; 84 ± 1 DIM) individually kept in metabolic cages. The design was a replicated 4 × 4 Latin square of 4 periods, 21 d each (14 d adaptation, 5 d for measurements). Goats were allocated to one of 4 treatments in a 2 × 2 factorial arrangement. Factors were no propylene glycol (C) or 5% of Propylene glycol (PG), and thermal neutral (TN; 15 to 20°C) or heat stress (HS; 12 h/d at 37°C and 12 h/d at 30°C) conditions. This resulted in 4 treatment combinations: TN-C, TN-PG, HS-C, and HS-PG. Feed intake, milk yield, milk composition, and blood parameters were measured. No significant interaction was detected between ambient temperature and PG effects. Compared to TN, HS goats had lower feed intake, FCM, and milk contents of fat, protein and lactose. The PG increased blood glucose and insulin, but decreased DMI, blood NEFA and β-hydroxybutyrate, resulting in lower milk fat with no change in milk protein content. In

conclusion, supplementation of heat-stressed dairy goats with propylene glycol did not affect milk yield or milk protein content, and caused milk fat depression syndrome.

Key Words: heat stress, propylene glycol, dairy goats

Table 1499.

Item	Treatment				SEM	*P* <	
	TN-C	TN-PG	HS-C	HS-PG		Temp[1]	PG
DMI, Kg/d	2.34	2.18	1.59	1.38	0.09	0.001	0.060
Milk yield, L/d	1.86	1.80	1.79	1.66	0.18	0.210	0.258
3.5% FCM[2], L/d	2.12	1.78	1.85	1.48	0.16	0.001	0.001
Milk composition, %							
Fat	4.43	3.46	3.78	2.89	0.21	0.009	0.001
Protein	3.55	3.54	3.14	3.15	0.21	0.074	0.999
Lactose	4.47	4.46	4.31	4.29	0.06	0.064	0.886
Blood measurements							
Urea, mg/dL	25.7	23.9	18.4	18.1	1.54	0.007	0.628
Glucose, mg/dL	56.1	61.7	56.1	57.6	1.28	0.120	0.012
Insulin, µg/L	1.14	1.54	1.03	1.43	0.23	0.637	0.091
Lactate, mmol/L	0.51	0.52	0.46	0.51	0.04	0.488	0.446
NEFA, mmol/L	0.10	0.06	0.07	0.03	0.02	0.116	0.021
β-hydroxybutyrate, mmol/L	0.65	0.48	0.77	0.48	0.07	0.369	0.002

[1] Effect of ambient temperature
[2] 3.5% fat-corrected milk = L of milk yield × [0.432 + 0.162 × (fat %)].

1500 (T259) The effects of technology use in feedlot production systems on the heat stress and blood metabolites of finishing steers. B. C. Bernhard*[1], C. L. Maxwell[1], C. F. O'Neill[1], B. K. Wilson[1], C. G. Hixon[1], C. Haviland[1], A. Grimes[1], M. S. Calvo-Lorenzo[1], C. J. Richards[1], D. L. Step[1], B. P. Holland[2], and C. R. Krehbiel[1], *[1]Oklahoma State University, Stillwater, [2]Merck, Volga, SD.*

Crossbred, black-hided steers (n = 336; initial BW = 379 ± 8 kg) were utilized in a RCBD (8 pens/treatment; 14 steers/pen) to determine the effects of technology use in feedlot production systems during the summer on heat stress. Treatments consisted of an all-natural treatment (receiving no growth promoting technologies; NAT), a conventional treatment (implanted with 40 mg of estradiol and 200 mg of trenbolone acetate on d 0, and fed 33 and 9 mg/kg of monensin and tylosin daily, respectively; CONV), and a CONV treatment plus the addition of a β-adrenergic agonist (zilpaterol hydrochloride at 6.76 g/ton for the last 20 DOF with a 3–4 d withdrawal; CON-V-Z). Blood was collected every 10 d during the β-agonist period (d 112 to 132) on seven steers/pen to determine blood gases, pH, and metabolites. The same subset of steers was evaluated for respiration rates and panting scores during the final 23 DOF, and rumen temperatures were continuously measured. All blood metabolites measured were within clinically normal concentrations throughout the experiment. Blood pH was greater for the CONV-Z cattle compared to the NAT cattle (7.41 vs. 7.37; $P < 0.01$) and CONV cattle intermediary (7.39) at d 122. The CONV-Z cattle had reduced lactate concentrations compared to NAT and CONV cattle at d 122 (13.5 vs. 28.9 and 27.3 mg/dL, respectively) and 132 (12.5 vs. 25.1 and 27.2 mg/dL, respectively; $P < 0.01$). Conventional cattle exhibited greater glucose concentrations than NAT and CONV-Z (88.9 vs. 83.9 and 82.5 mg/dL, respectively; $P < 0.01$). The CONV-Z cattle exhibited greater potassium concentrations than NAT and CONV cattle at d 122 (4.40 vs. 4.16 and 4.23 mmol/L, respectively; $P < 0.01$). The CONV-Z cattle showed increased severity in the morning panting score compared to CONV and NAT cattle (1.23 vs. 1.00 and 1.08, respectively; $P < 0.03$), and the afternoon panting score compared to CONV cattle (1.84 vs. 1.67; $P < 0.01$), with NAT cattle intermediary (1.76). Respiration rates were lowest for CONV cattle, intermediate for NAT cattle, and highest for CONV-Z cattle in the morning (99.5 vs. 105.0 vs. 112.8 breaths/min, respectively) and afternoon (120.1 vs. 125.8 vs. 133.8 breaths/min, respectively; $P < 0.01$). The NAT cattle had lower mean rumen temperatures compared to CONV cattle in the morning (39.56 vs. 39.71°C; $P < 0.01$) and afternoon (40.70 vs. 40.95°C; $P < 0.01$), with CONV-Z cattle intermediary (39.62 and 40.88°C). Based on these results, zilpaterol increased respiration score and rate, as noted on the product label.

Key Words: β-adrenergic agonist, heat stress, respiration rate

1501 (T260) The effects of technology use in feedlot production systems on feedlot performance, carcass characteristics, and feeding behaviors of crossbred beef steers. C. L. Maxwell[1], B. C. Bernhard*[1], C. F. O'Neill[1], B. K. Wilson[1], C. Hixon[1], C. Haviland[1], A. Grimes[1], M. S. Calvo-Lorenzo[1], D. L. VanOverbeke[1], G. G. Mafi[1], C. J. Richards[1], D. L. Step[1], B. P. Holland[2], and C. R. Krehbiel[1], *[1]Oklahoma State University, Stillwater, [2]Merck Animal Health, DeSoto, KS.*

The objectives of this study were to examine the effects of a technology enhanced system compared to an all-natural production program on feedlot performance, feeding behaviors and carcass characteristics. Crossbred beef steers (n = 54; initial BW = 391 ± 2.6 kg) were randomized to one of two treatments in a RCBD (13 to 14 steers/pen; 27 steers/treatment). Treatments consisted of an all-natural treatment (NAT), and a conventional treatment (CONV-Z). The NAT cattle received no growth promoting technologies. The CONV-Z cattle were implanted with 40 mg of estradiol and 200 mg of trenbolone acetate on d 0, and were fed 33 and 9 mg/kg of monensin and tylosin daily, respectively as well as zilpaterol hydrochloride at 6.76 mg/kg (90% DM basis) for the last 20 DOF. Gain was improved by 45.1% (1.77 vs. 1.22 kg/d; $P < 0.01$) and feed efficiency by 45.5% (0.163 vs. 0.112; $P < 0.01$) for CONV-Z steers compared to NAT steers. Daily water intake was numerically greater for NAT steers compared to CONV-Z steers consistently throughout the study (56.26 vs. 53.59 L/d; $P = 0.43$).

Thus, total water and feed efficiency was improved by 50% for CONV-Z steers compared to NAT steers (0.027 vs. 0.018; $P < 0.01$). NAT steers consumed more (8.22 vs. 7.59 meals/d; $P = 0.03$), smaller feed meals (1.34 vs. 1.46 kg/meal; $P = 0.02$), resulting in more time spent at the feed bunk (85.36 vs. 73.19 min/d; $P < 0.01$) throughout the day compared to CONV-Z steers. Water meal length was greater for NAT steers compared to CONV-Z steers (3.23 vs. 2.58 min/meal; $P < 0.01$), resulting in more time spent at the water trough throughout the day (23.71 vs. 17.80 min/d; $P < 0.01$). Dressing percentage was increased by 2.17% units (65.31 vs. 63.14; $P < 0.01$) for CONV-Z steers compared to NAT steers, resulting in a 48 kg heavier carcass (388 vs. 340, kg; $P < 0.01$). *Longissimus* muscle area was increased by 11.09 cm^2 (87.25 vs. 76.15, cm^2; $P < 0.01$) for CONV-Z steers compared to NAT steers, and marbling score was greater for NAT steers compared to CONV-Z steers (504 vs. 410; $P < 0.01$). The results of this experiment show that CONV-Z production improves feedlot performance and resource-use efficiency compared to NAT with differences in feed and water intake behavior.

Key Words: beef cattle, conventional, natural

1502 (T261) Survey of fatty acid profile of milk fat in Italian Water buffalo. M. G. Manca[1], G. Cosenza[2], E. Apicella[2], A. Pauciullo[3], A. Coletta[4], A. Nudda[*1], N. P. P. Macciotta[5], L. Zicarelli[6], and L. Ramunno[7], *[1]Dipartimento di Agraria, University of Sassari, Italy, [2]Dep. of Agriculture, University of Naples Federico II, Italy, [3]ISPAAM, Laboratory of Animal Cytogenetics and Gene Mapping, National Research Council, Naples, Italy, [4]ANASB, Italian National Association of Buffalo Breeders, Caserta, Italy, [5]Università di Sassari, Italy, [6]Dep. of Veterinary Medicine and Animal Production, University of Naples Federico II, Italy, [7]Dep. of Agriculture, University of Naples, Italy.*

Dairy buffalo farming has a relevant economic importance in Italy, mainly due to the high value of the most important dairy product, the mozzarella. Fat is a major component of buffalo dairy products. Its consumption can provide great opportunities for increasing the intake of fatty acids (FA) with potential health properties, especially as far as CLA isomers and omega-3 FA are concerned. Therefore the purpose of this survey was to investigate the variation in FA profile of milk fat of Mediterranean water buffalo fed a total mixed ratio composed mainly by corn silage and pelleted concentrate. Milk samples from 398 Italian Water buffaloes farmed in 18 herds located in Campania were collected at different months of production. FA composition of milk samples was determined by GC. Data were analyzed using a linear model, that includes age, days in milk (DIM) and month of calving as fixed effects and herd as a random effect. Saturated FA (SFA) represented 71.6% of total FA (ranging from 57.9% to 85.9%) and C16:0 and C18:0 were the most represented (34.8% and 11.1%, respectively). Monounsaturated FA (MUFA) were 25.17% of total milk FA (ranging from 12.6% to 37.4%) and C18:1c9 represent the majority (76% of total MUFA). The concentration of polyunsaturated FA (PUFA) was 3.21% of total FA ranging from 1.39% to 5.11%. with C18:2 n6 predominating (49% of total PUFA) while C18:3 n3 was present in a lower amount 0.32% of total FA. Trans FA (TFA) represented 1.70% of total FA with C18:1 t11 the most abundant (59% of total TFA). CLA isomers amounted to 0.76% of total milk FA and the isomer c9, t11 CLA represent the majority (55% of total CLA). Statistical analysis showed that milk FA were not significantly influenced by the age of animal, except for TFA content ($P < 0.05$) that was higher in younger animals (1.94%). Month of calving significantly influenced FA composition of buffalo milk only for total CLA and TFA ($P < 0.05$), evidencing a seasonality effect of these traits. DIM affected significantly all the group of FA analyzed ($P < 0.01$) denoting a marked lactation curve effects. The FA profile obtained in this study is typical of animals farmed in intensive systems, with a reduced occurrence of unsaturated fatty acids, compared to graze-based systems.

Key Words: buffalo milk, fatty acid profile

1503 (T262) Comparative study between 5% copper sulfate and a β-ionone and limonene solution in a split footbath. A. C. Thompson*, and J. M. Bewley, *University of Kentucky, Lexington.*

Digital dermatitis (DD) is a major cause of lameness in dairy herds (NAHMS, 2002) often controlled with a copper sulfate footbath. Alternative solutions are being explored as copper retards crop growth and yield when waste footbath solution is applied to fields. An alternative to copper sulfate is a β-ionone and limonene solution (RotNot, Neogen Corporation, Lexington, KY). The objective of this study was to compare the frequency and severity of DD using a β-ionone and limonene solution versus copper sulfate. The study was performed on a commercial farm in Kentucky from March 2, 2013,through May 25, 2013, with 91 lactating Holstein cows. Footbath solutions were delivered through the use of a split footbath with a β-ionone and limonene solution, at a concentration of 1:1000 on the right hooves and 5% copper sulfate on the left hooves. The DD lesions were scored every 3 wk using the Döpfer scoring system (Döpfer et al., 1997): M0 indicates no lesion; M1 represents an early growth less than 2 cm in size and generally not painful; M2 indicates a growth greater than 2 cm and painful to the touch; M3 represents a growth in the healing stage covered with a scab; and M4 designates a chronic non painful growth. The FREQUENCY procedure of SAS (SAS Institute Inc., Cary, NC) was used to run a chi-square test. The results indicated a significant change in DD frequency from the beginning (29.1%) to the end (52.7%) of the study across treatments ($P < 0.01$). McNemar's test statistic indicated that no significant difference existed in the proportions of M1 and M2 lesions between the beginning (21.9%) and end of the

study (27.5%) for 5% copper sulfate ($P = 0.42$). McNemar's test indicated a significant increase in M1 and M2 lesions with a β-ionone and limonene solution from the beginning (13.2%) to the end (52.7%) of the study ($P < 0.01$). These results suggest that copper sulfate was more effective at preventing DD lesions than a β-ionone and limonene solution. A β-ionone and limonene solution footbath may not be a viable alternative to 5% copper sulfate footbath for DD lesion prevention.

Key Words: digital dermatitis, copper sulfate, split footbath, hoof care

1504 (T263) Comparison of milk components before and after passing through a novel inline milk filter.

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The UV Milk Filter (GERA Ltd., Voronezh, Russia) is a new inline filter designed to help remove foreign matter and abnormalities in milk. UV Milk Filters are different from standard single-ply polyester fabric because they are spindle woven, making them thicker than the industry standard. The objective of this study was to determine if passing milk through the UV Milk Filter changed milk fat, protein, lactose, solids, or SCC. Samples were collected at the University of Kentucky Coldstream Dairy between Nov. 30 and Dec. 10, 2013. Before each milking, a new UV Milk Filter was placed in the filter holder within the pipeline. When milking was completed, three 90-mL samples were collected from two different points: 1) at the receiver jar, before the milk had gone through the filter, and 2) at the point the milk enters the bulk tank, after the milk from the receiver jar had passed through the filter. Therefore, a total of six samples were collected at each milking for 20 milkings ($n = 120$). Mean fat, protein, lactose, solids, and SCC were calculated for each milking ($n = 20$). The GLM procedure of SAS (Cary, NC) was used to determine the effects of the UV Milk Filter on milk component averages taken before and after milk had passed through the filter. Results are depicted in Table 1504. The results show that the UV Milk Filter can successfully filter milk without changing its composition.

Key Words: UV milk filter, milk composition

Table 1504. Milk component averages and corresponding *P*-values for the differences in milk before and after it had passed through the UV Milk Filter

	Treatment		
Component	Before Filter	After Filter	*P*-value
Fat	4.48%	4.43%	0.84
Protein	3.09%	3.12%	0.64
Lactose	4.90%	4.91%	0.91
Solids	8.93%	8.96%	0.53
SCS	3.30	3.43	0.75