0871 Comparative effect of two commercial preparations of bovine somatotropin on milk yield and overall performance in Chilean dairy cows. M. A. Barrios[1], P. Melendez[*2], and M. Duchens[1], [1]*University of Chile, Santiago, Chile,* [2]*University of Missouri, Columbia*.

To compare the effect of two commercial preparations of bSTr available in Chile on milk production and overall performance of dairy cattle, 348 confined Holstein cows from a high-producing farm located in Casablanca, Valparaíso Region (33.31 S, 71.40 W) were used. Cows were randomly assigned from 70–76 DIM to one of two treatment groups. Group 1 (n = 161) was Boostin® (LG LifeSciences, South Korea) and Group 2 (n = 187) was Lactotropin® (Elanco, USA). In both groups, the hormone was administered every 14 d to about 30 d before dry off. Information was obtained from computerized systems and collected until the end of the eighth cycle of treatment (approximately 180 DIM). Milk data was processed through a repeated measures ANOVA. Fertility was analyzed by logistic regression to evaluate the risk of pregnancy at first insemination. Days open were analyzed with Kaplan-Meier survival analysis to compare days at pregnancy. Frequencies of clinical mastitis were analyzed by logistic regression. Monthly SCC linear scores were analyzed using repeated measures ANOVA. Finally, culling rate was assessed by a Kaplan-Meier survival analysis. No significant differences in the interaction of time by treatment were observed for milk yield (P = 0.07), averaging 42.3 L/d for Lactotropin®, and 42.8 L/day for Boostin®. No significant differences on calving-to-conception interval were recorded during the first 180 d of lactation (P = 0.19), showing a median of 101 d in Lactotropin® group and 90 d in cows treated with Boostin®. Conception rate at first insemination was 40% in cows treated with Boostin® and 32.8% in cows treated with Lactotropin® (P = 0.16). Cows treated with Lactotropin® have a higher incidence of clinical mastitis (33.5%) compared to Boostin® cows (21.1%) (P < 0.01). However, no significant differences were observed in SCC between groups. Finally, treatment has no effect on culling rate (P = 0.78). In conclusion, there are no substantial differences between hormone preparations regarding milk production, udder health, and fertility in high-producing Holstein cows.

Key Words: bST, fertility, mastitis, milk yield

LIVESTOCK WATER SYMPOSIUM

0872 Understanding blue and green water for feed production in animal agriculture. J. G. Warren*, *Oklahoma State University, Stillwater*.

Increasing demand for animal protein combined with concern about water scarcity demands thoughtful considerations of the water footprint of animal agriculture. This water footprint can be discussed in the context of green water, which is rainfall that does not become runoff, and blue water, which is surface or groundwater that is consumed as a result of the animal production system. Much of the green and blue water utilized by animal agriculture provides for the production of grain and forages. As such, the type of feed utilized by specific animal production systems can dramatically influence the water footprint of the system. Grazing systems will generally result in larger water footprints than grain-based production systems because the higher quality grain-based systems provide for more gain per unit of water used. However, this reduced water footprint comes with increased environmental impacts such as erosion and offsite nutrient losses from the grain production systems. Furthermore, pasture-based systems overwhelmingly utilize green water, which would likely be consumed at similar rates if the pasture was used for meat production or wildlife habitat. Lastly, regional differences in soil type, rainfall distribution, and atmospheric water demand (evapotranspiration) also influence the water footprint of animal agriculture by impacting crop water use efficiency.

Key Words: life cycle analysis, groundwater, feed production

0873 Mineral balances including TMR, drinking water and assay minerals in the milk. A. R. Castillo*, *UC Cooperative Extension, Merced, CA*.

Drinking water for dairy animals or manure for soil applications can be both a source of mineral nutrients and toxic substances. Commercial dairy production systems (grazing or indoors) are evolving to a larger scale, with more cows per farm and milk production per cow. Including assayed concentrations of minerals in the diet, drinking water and milk could improve the accuracy of calculations of herd or pen mineral balances. The aim of this presentation is to discuss mineral contents in TMR, water, and milk on mineral balances and excretion in lactating dairy cows. A mineral balance study in California on 40 dairies with low total salts (TS) drinking water for lactating dairy animals (0.2 to 1.5 g TS/L) was performed to compare TMR mineral content with the NRC requirement, with and without including minerals in drinking water, and the average NRC values for milk mineral concentrations to assayed minerals in the bulk tank milk. Most TMR minerals were in excess of NRC requirements. When including minerals in drinking water, Mg, Na, Cl, S, and Cu increased TMR median mineral contents by about 5% (ranging from 3.6% for S to 7% for Na). The assayed values of minerals in milk were lower than NRC averages (i.e., Mg, 49%; Na, 58%; Cu, 295%; and Fe, 525%). Estimated excretions of minerals via manure varied substantially across farms. Farms in the 10th percentile had estimated mineral excretions via manure 2 to 3 times less than those in the 90th. For example, daily K median excretion was 321 g/cow, from 240 (10th) to 425 g/cow (90th

percentile), daily Na excretion varied from 69 (10th) to 168 g/cow (90th percentile) with a median of almost 100 g. Median Cu and Zn excretions were 417 and 1700 mg/cow per day, but Cu excretion increased more than 3 times and Zn more than 2.5 times from the 10th to 90th percentiles. Estimates of dairy farm mineral balances should be based on assayed mineral concentrations in dietary ingredients, drinking water, and milk. Accurate estimates of mineral balance can then be used to manage excess minerals (diet and manure) and improve animal mineral nutrition, nutrient management plans, and soil mineral nutrition.

Key Words: dairy sustainability, dairy cows, drinking water, mineral balances

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0874 Water: The frequently neglected nutrient in growing and finishing diets. J. J. Wagner* and T. E. Engle, *Colorado State University, Fort Collins*.

The objective of this presentation is to describe water requirements of feedlot cattle and to discuss the effects of water sulfate concentration on water intake (WI). The Recommended Nutrient Allowances for Beef Cattle report was published by the National Research Council (NRC) in 1945 and was revised in 1950, 1958, 1963, 1976, 1984, and 1996 (update 2000). Water requirements were first described in the 1976 NRC and warranted a separate chapter in 1984. However, in the much aligned 1996 (update 2000) NRC report, the discussion of water was relegated to a section in the vitamin chapter. The findings of Winchester and Morris (1956), describing WI as a function of BW, DMI, and ambient temperature, were used as the basis of the water discussion in the 1976, 1984, and 1996 (update 2000) NRC publications. Also included in the 1996 (update 2000) revision was discussion of an equation predicting WI by feedlot cattle based on maximum daily temperature (Tmax), DMI, precipitation, and dietary salt concentration (Hicks et al., 1988). Arias and Mader (2011) developed models predicting WI from several environmental measurements. Solar radiation (SR, W/m^2) and thermal heat index (THI; Thom, 1959; NOAA, 1976) were the most important factors predicting WI during summer; however, Tmax and THI were the best predictors of WI during winter. Sexson et al. (2012), using a univariate analysis, found that WI from April through October was positively related to all measures of temperature, negatively related to all measures of relative humidity, positively related to wind velocity, negatively related to sea level barometric pressure, positively related to DMI, and negatively related to BW. A multivariate model predicting WI accounted for 32% of the variation in WI. Loneragan et al. (2001) and Sexson et al. (2010) demonstrated reduced WI for steers consuming water with >1000 mg/L sulfate as compared to steers consuming water with <1000 mg/L sulfate. The observed reduction in WI associated with increased sulfate concentration was greater during summer months as compared with spring or fall. Water is described in a separate chapter in the recently released Nutrient Requirements of Beef Cattle, Eighth Revised Edition (National Academies of Sciences, Engineering, and Medicine, 2016). Equations predicting WI in the eighth revised edition were developed using surface regression of the tabular values published by Winchester and Morris (1956) and include current effective temperature index, as computed from temperature, relative humidity, wind speed, and hours of daylight.

Key Words: water intake, water sulfate concentration, feedlot cattle

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0875 Simultaneous monitoring of water consumption in eight double pens as a tool for improving welfare and predicting diseases and unwanted behavioral changes in finisher pigs. K. N. Dominiak*[1], L. J. Pedersen[2], and A. R. Kristensen[1], [1]*University of Copenhagen, Department of Large Animal Sciences, Frederiksberg, Denmark,* [2]*Aarhus University, Department of Animal Science Behavior and Stress Biology, Aarhus, Denmark*.

Increasing animal welfare and heightening the level of management by sensor-based monitoring of water consumption in finisher pigs are the overall objectives of this study. It has previously been shown that water monitoring can be used to predict outbreaks of diarrhea in weaner pigs at the section level, and diarrhea or unwanted behavioral changes in finisher pigs at the double-pen level. A double pen is defined as two neighboring pens getting their water supply from the same pipe on which the sensor is placed. In this study the hourly water consumption was measured in a commercial farm by water flow sensors in eight double pens each containing 36 finisher pigs and distributed with two in each of four sections. The eight individual time series are modeled simultaneously in one dynamic linear model (DLM), and variance components are estimated by an EM-algorithm. Insertion dates are not synchronized but follow the production cycle, demanding the DLM to handle a varying number of time series at any given time. The diurnal drinking pattern is described by a combination of three harmonic waves (24 h, 12 h, and 8 h wavelength) as well as underlying levels and trends for herd, sections, and double pens. Preliminary results indicate a strong correlation between double pens in the same section as well as some pen-specific effects. In this study simultaneous monitoring is used to detect diseases (diarrhea, influenza, and respiratory diseases), as well as the unwanted behavioral changes preceding outbreaks of tail bite and fouling. Early warnings can be generated either independently at the double-pen level or merged at the section level or herd level. This quality can be used as a prioritizing tool minimizing the occurrence of false positive alarms if the warning pattern is highly different from what can be expected based on knowledge of the specific disease or behavioral change. This study is a part of an ongoing project aiming to improve the welfare and productivity of

growing pigs using advanced ICT methods.

Key Words: sensor-based, early warning, dynamic linear model

0876 Growth and health performance of dairy calves drinking reverse osmosis water compared to municipal water. N. D. Senevirathne*, J. L. Anderson, and M. Rovai, *Dairy Science Department, South Dakota State University, Brookings*.

Our objective was to determine effects of drinking reverse osmosis (RO) water versus municipal city (MC) water on growth and health performance of calves. Twenty-four Holstein calves (12 females, 12 males; 2 d old, 44.6 ± 6.10 kg BW), housed in individual hutches, were used in a 10-wk randomized complete block design study. Calves were blocked by birthdate and sex. Treatments were RO water (Culligan Water Filtration System, Brookings, SD) versus MC water (Brookings Municipal Utilities, Brookings, SD) which contained 13 and 387 mg/L total dissolved solids, respectively. Milk replacer (28% CP; 18% Fat) was fed twice daily during wk 1 through 5 and then once daily during wk 6. At each feeding, 0.45 kg of dry milk replacer was mixed with 2.8 L of respective water type, according to treatment. Calves were fed water and starter pellets ad libitum throughout the study. All intakes were recorded daily. Daily total respiratory scores (healthy ≤ 3, sick ≥ 5) were calculated from the sum of scores for rectal temperature, cough, ocular, and nasal discharge. Fecal consistency scores (0 = firm, 3 = watery) were also recorded daily. Body weights (BW) and frame growth were measured 2 d every 2 wk and jugular blood samples were collected 1 d every 2 wk at 3 h after morning feeding. Fecal grab samples were collected 5×/d for 3 d during wk 10 for analysis of total tract digestibility (TTD) of nutrients. Results were analyzed using MIXED procedures with repeated measures and Tukey's test for means comparison in SAS 9.4. Significant differences were declared at $P < 0.05$ and tendencies were declared at $0.05 \leq P < 0.10$. Total DMI and G:F increased more over time for RO than MC. Water intake was less in RO than MC, indicating more efficient water use by calves. Frame growth, BW, ADG, serum glucose, plasma urea nitrogen (PUN), β-hydroxyl butyrate (βHB), TTD of DM and CP were similar. Fecal scores tended to be less (firmer) in calves on RO, with an interaction by time. Respiratory scores had a tendency to decrease more over time when calves drank RO. Results demonstrated calves drinking RO had similar growth with improved G:F and health scores over time compared to MC.

Key Words: reverse osmosis water, growth performance, dairy calf

Table 0876.

Item	Treatment		SEM	*P*-values		
	RO	MC		Treatment	wk	Treatment × wk
DMI, g/d	1,508	1,502	83.2	0.72	<0.01	<0.01
Water intake, kg/d	3.66	3.85	0.36	<0.01	<0.01	0.27
BW, kg	70.2	70.2	1.79	0.99	<0.01	0.84
ADG, kg/d	0.72	0.69	0.04	0.69	<0.01	0.12
G:F	0.54	0.52	0.02	0.22	<0.01	<0.01
Glucose, mg/dL	111.2	105.9	3.04	0.12	<0.01	0.76
βHB, mg/dL	32.8	33.1	1.05	0.80	<0.01	0.83
PUN, mg/dL	16.3	15.8	0.62	0.45	<0.01	0.46
DM TTD, %	92.9	92.0	0.75	0.43	-	-
CP TTD, %	76.9	73.1	2.59	0.34	-	-
Fecal score	0.60	0.69	0.03	0.09	<0.01	<0.01
Respiratory score	1.95	2.03	0.05	0.32	<0.01	0.02

0877 Effect of protein supplementation on low-quality forage utilization and nitrogen balance by lambs drinking saline water. J. I. Arroquy*[1], A. Lopez[2], and A. Juarez Sequeira[3], *[1]INTACONICET–UNSE, Santiago del Estero, Argentina, [2]INTA EEA Santiago del Estero, Santiago del Estero, Argentina, [3]CONICET-FAyA UNSE, Santiago del Estero, Argentina.*

The aim of this study was to access the effect of protein supplementation on intake, digestion, and N utilization in lambs fed a low-quality hay (*Panicum maximum;* 6.4% CP, 79.5% NDF, 54.3% ADF) and drinking high-salt water. Twenty Hampshire lambs ($n = 4$; 31 ± 4 kg BW) allocated to in individual cages in a ten treatments by two period (10 × 2) trial. Treatments consisted (2 × 5 factorial) of two water qualities (WQ; low salt, LS; 442 mg/L of total dissolved solids (TDS) and 108 mg/L sulfate; and high salt, HS; 8358 mg/L TDS and 6363 mg/L sulfate) and five soybean meal levels (SBM; 0, 0.25, 0.50, 0.75, and 1.00% BW/d). Supplemental SBM × WQ interactions were significant for forage OM intake (FOMI; $P = 0.04$), total OM intake (TOMI; $P = 0.04$), whereas there was only a tendency for total tract digestibility OM intake (TTDOMI; $P = 0.07$). On average, HS had lower FOMI ($P < 0.01$; 33.0 vs. 26.1 g/kg $BW^{0.75}$), TOMI ($P < 0.01$; 42.2 vs. 35.3 g/kg $BW^{0.75}$), and TTDOMI ($P = 0.01$; 23.6 vs. 21.3 g/kg $BW^{0.75}$) than LS, while SBM levels did not significantly affect FOMI ($P = 0.86$) and TOMI ($P = 0.25$). In contrast, TTDOMI linearly increased in response to SBM ($P < 0.01$). There was no SBM × WQ interaction for water intake ($P = 0.60$), which tended to respond to SBM levels ($P = 0.07$) in linear fashion

($P < 0.01$), but was not affected by WQ ($P = 0.39$). There was no SBM × WQ interaction for total tract OM digestibility (TTOMD; $P = 0.69$). SBM linearly increased TTOMD ($P < 0.01$), and LS had lower TTOMD than HS ($P < 0.01$; 55.4 vs. 59.3% for LS and HS, respectively). Nitrogen balance was not affected by SBM × WQ interaction ($P > 0.12$), but N utilization (N-retained/N-intake ratio; $P < 0.01$) was. Regardless of WQ, we observed that SBM exerted a quadratic and linear response for N utilization ($P = 0.01$) and balance ($P < 0.01$). In LS, N balance and N utilization became positive at 0.25% of SBM, but in HS were positive only at the two greatest level of SBM (0.75 and 1.00%). In conclusion, according to our results lambs fed low-quality forage require greater levels of protein supplementation to maximize total digestible OM intake, N balance, and N utilization when they drink high-salt water compared to those drinking low-salt water.

Key Words: nitrogen balance, supplementation, saline water

MEAT SCIENCE AND MUSCLE BIOLOGY

0878 Chemical composition and expression of genes involved in lipid metabolism in the muscle of Nellore and Angus young bulls fed whole shelled corn diet.

M. M. Ladeira*[1], P. D. Teixeira[1], M. P. Gionbelli[1], M. L. Chizzotti[2], J. R. R. Carvalho[1], D. M. Oliveira[1], and T. C. Coelho[1], [1]*Universidade Federal de Lavras, Lavras, Brazil,* [2]*Universidade Federal de Viçosa, Viçosa, Brazil*.

The objective was to evaluate expression of genes involved in lipid metabolism and chemical composition of *longissimus dorsi* (LD) muscle of Nellore and Angus bulls fed whole shelled corn (WSC) or a ground corn (GC) diet. Twenty-eight bulls with average initial body weight of 378 ± 8.7 kg were used in a completely randomized design and arranged as a 2 × 2 factorial (2 breeds and 2 diets). The GC diet had 30% corn silage and 70% of a concentrate based on corn and soybean meal. The WSC diet had 85% whole shelled corn and 15% of a pellet based on soybean meal and minerals. After being harvested, samples were taken from the LD muscle between the 12th and 13th ribs for centesimal composition analyses and gene expression, which was analyzed by RT-qPCR. The model included the fixed effects of breed, diet, and their interaction. Expression of *PPARA* was greater in the LD of Nellore bulls (Table 1; $P < 0.01$) and also when bulls were fed the WSC diet ($P = 0.04$). Opposite results were found for *SREBF1* expression, which was less when bulls were fed the WSC diet ($P < 0.01$) and less in Nellore bulls ($P = 0.03$). *PPARG* and carnitine palmitoyl transferase 2 (*CPT2*) expression was downregulated in the LD muscle of Nellore bulls fed WSC and upregulated in the LD of Angus fed the same diet. Expression of lipoprotein lipase (*LPL*), fatty acid binding protein 4 (*FABP4*), acetyl CoA carboxylase (*ACACA*), and stearoyl-CoA desaturase (*SCD1*) was greater ($P < 0.05$) in the LD of Nellore bulls fed the GC diet. However, diets did not affect the expression of these genes in the LD muscle of Angus bulls. Fatty acid synthase (*FASN*) expression was greater in the LD of Nellore bulls ($P < 0.01$) and when animals were fed WSC ($P < 0.01$). Expression of acyl-coenzyme A oxidase 1 (*ACOX*) was greater for Angus fed WSC ($P = 0.04$). Meat from Angus bulls had greater intramuscular fat than meat from Nellore bulls (4.95 and 4.30; $P = 0.05$). However, there was no effect ($P > 0.05$) of diet on intramuscular fat. Moisture and protein were not affected ($P > 0.05$) by diet and breed. In conclusion, expression of *PPARA* and *SREBF1* have opposite regulation mechanisms in bovine muscle, regardless of the subspecies. Diets affected the expression of some genes involved in lipid metabolism differently in Nellore and Angus bulls.

Key Words: lipogenesis, marbling, *PPAR*, *SREBF1*, transcription factor

Table 0878.

Table 1. Expression of genes involved in lipid metabolism in the *longissimus dorsi* muscle of Nellore and Angus young bulls fed whole shelled corn (WSC) and ground corn (GC) diet.

	Nellore		Angus			*P*		
Genes	GC[1]	WSC[2]	GC	WSC	SEM	Breed	Diet	B*D
PPARA	3.78	4.72	1.00	2.83	0.32	<0.01	0.04	0.22
PPARG	2.61 b	1.00 c	2.8 b	5.67 a	0.33	<0.01	0.86	<0.01
SREBF1	5.25	1.00	5.71	2.61	0.28	0.03	<0.01	0.10
LPL	3.78 a	1.00 c	1.77 b	1.36 bc	0.29	0.04	<0.01	0.01
FABP4	13.47 a	1.00 c	8.93 b	10.16 b	0.86	0.34	<0.01	<0.01
ACACA	7.16 a	1.00 c	3.37 b	1.84 b	0.45	1.00	<0.01	<0.01
FASN	3.87	4.34	1.00	1.83	0.22	<0.01	0.01	0.16
SCD1	3.18 a	1.00 c	1.95 b	1.67 b	0.21	0.91	<0.01	0.02
CPT2	7.2 a	1.00 d	2.02 c	2.87 b	0.27	0.92	<0.01	<0.01
ACOX	1.33 c	1.00 c	2.67 b	5.29 a	0.38	<0.01	0.52	0.04

[1]GC: Diet containing 30% roughage and 70% concentrate
[2] WSC: Diet with 85% whole shell corn and 15% of a *pellet* based on soybean meal and minerals