

examined the effect of myostatin on turkey myogenic satellite cells and embryonic myoblasts. Compared with controls, proliferation of both turkey embryonic myoblasts and satellite cells was inhibited between 26 and 45% in serum-free medium containing 20 ng/ml myostatin. While individual turkey satellite cell clones differed in their responsiveness to myostatin ( $P < 0.05$ ), there were no significant differences in the responsiveness of fast and slow growing cells as groups ( $P > 0.05$ ). A slow growing clone that exhibited the greatest response to myostatin also exhibited the greatest depression of differentiation with this growth factor ( $P < 0.05$ ). All other turkey satellite cell clones exhibited similar responses to the differentiation depressing effects of myostatin ( $P > 0.05$ ). However, myostatin had no effect on turkey embryonic myoblast differentiation ( $P > 0.05$ ). When exposed to myostatin, all fast growing clones and one slow growing clone increased their expression of decorin, a growth inhibitor ( $P < 0.05$ ). The present study demonstrates that myogenic cells differ in their responsiveness to myostatin and suggest a role for decorin in myostatin action in muscle development.

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**Key Words:** Myostatin, Muscle, Decorin

**W112 A novel regulatory mechanism of muscle protein anabolism in steers.** A. A. Gingras<sup>\*1</sup>, P. Y. Chouinard<sup>1</sup>, Y. Couture<sup>2</sup>, P. Julien<sup>3</sup>, P. Dubreuil<sup>2</sup>, A. Myre<sup>1</sup>, K. Bergeron<sup>1</sup>, T. A. Davis<sup>4</sup>, and M. C. Thivierge<sup>1</sup>, <sup>1</sup>Université Laval, Qc, Canada, <sup>2</sup>Université de Montréal, Qc, Canada, <sup>3</sup>Laval University Medical Ctr (CHUL), Qc, Canada, <sup>4</sup>Baylor College of Medicine, Houston, Texas.

Omega-3 long-chain polyunsaturated fatty acids (n-3LCPUFA) have been shown to improve insulin sensitivity in human pathologies, such as obesity and diabe-

tes type II. The aim of this study was to investigate the ability of n-3LCPUFA to regulate protein anabolism in growing steers. Two groups of three Simmental x Red Angus steers were used in a switch back design with two treatments assigned over three 35-d periods. Steers were fed a basal diet composed of 13% grass silage, 31% corn silage and 56% concentrates. They were fitted with chronic catheters in the abomasum and in a mesenteric artery. Oil infusions (5% DMI) were continuously administered into the abomasum (control oil: 40% olive: 60% cottonseed; n-3LCPUFA oil: 100% Menhaden oil). On the 5<sup>th</sup> wk of each period, hyperinsulinemic-euglycemic-euaminoacidemic clamps (10, 40, 160 mU insulin/kg-h) were performed to measure insulin sensitivity. A 9-h continuous infusion (1.667  $\mu\text{mol/kg-h}$ ) of L[1-<sup>13</sup>C]phenylalanine (Phe) was conducted to assess protein metabolism. High dietary intake of n-3LCPUFA resulted in the incorporation of n-3LCPUFA into muscle phospholipids. With Menhaden oil infusion, n-3LCPUFA were increased ( $P < 0.001$ ) in muscle phosphatidylcholine from 11 to 23% (by weight). In muscle triglycerides n-3LCPUFA were increased ( $P < 0.01$ ) from 0.27 to 0.80%. Insulin-stimulated amino acid disposal tended to increase (+42%,  $P = 0.09$ ) with infusion of n-3LCPUFA. A 23% reduction ( $P = 0.04$ ) in whole body irreversible loss rate of Phe also occurred in n-3LCPUFA-enriched steers. Based on significant higher Phe isotopic enrichment ( $P = 0.03$ ) and on unaltered arterial concentrations of Phe (64 mM), it is likely that this reduction in Phe flux could result from a decrease in whole body proteolysis. These changes in hormonal or metabolic sensitivity in n-3LCPUFA-enriched steers may underlie the 18% decrease (tendency:  $P = 0.16$ ) of feed conversion resulting from a reduction ( $P = 0.05$ ) in food intake. These findings suggest that muscle n-3LCPUFA could act as a potent mediator of anabolism in growing steers.

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**Key Words:** Omega-3 Long-Chain Fatty Acids, Insulin Sensitivity, Steers

## International Animal Agriculture

**W113 Environmental factors and genetic parameters for birth weight in the indigenous Chiapas ovine breed.** G. Campos<sup>1</sup>, H. Castro-Gómez<sup>1</sup>, R. López<sup>1</sup>, R. Perezgrovas<sup>2</sup>, and H. Castillo-Juárez<sup>\*3</sup>, <sup>1</sup>Universidad Nacional Autónoma de México, Ciudad Universitaria, México D.F., <sup>2</sup>Universidad Autónoma de Chiapas, Teopisca Center, Los Altos de Chiapas, México, <sup>3</sup>Universidad Autónoma Metropolitana, Calzada del Hueso, México D.F.

The aim of this study was to estimate the heritability, the permanent environment effect and the breeding values for birth weight (BW) in a sheep flock from a Mexican local indigenous ovine breed named Chiapas. Fixed effects (environmental factors) affecting BW were also determined. This information is required for breeding purposes. The flock belongs to the indigenous Tzotzil community from the mountains of Chiapas, in the south of Mexico. In 1991 a breeding program supervised by the Teopisca Center from the University Autonomous of Chiapas was introduced in order to improve the quality of this flock based on the Tzotzil community breeding objectives and goals. Significant fixed effects were year of lambing, sex of the lamb, number of lambing ( $P < 0.01$ ). An animal model, that included significant fixed effects, and DFREML software was used to estimate heritability and the permanent environment effect. The heritability of BW was 0.27  $\pm$  0.10 and the permanent environment effect was 0.26  $\pm$  0.05. The breeding values for BW ranged from  $\hat{a} \pm \sigma \cdot 0.27$  to 0.40 kg. The permanent environment effect was rather large and similar in magnitude to the additive genetic variation observed, showing that the maternal environment is very important for the variation of BW, and that BW can be used in their breeding programs.

**Acknowledgements:** Thanks to the indigenous Tzotzil community of Chiapas.

**Key Words:** Genetic Parameters, Birth Weight, Indigenous Sheep Breed

**W114 Design of breeding objective including trypanotolerance for African cattle smallholders.** U. Janßen-Tapken<sup>\*</sup>, Y. Li, and H. N. Kadarmideen, Swiss Federal Institute of Technology, ETH Zentrum, Zurich, Switzerland.

A major disease constraint on livestock productivity in Eastern Africa is Trypanosomosis which directly affects the livelihood of poor livestock keepers. The objective of this study was to design a breeding goal including trypanosomosis to increase trypanotolerance in cattle in pastoral, agro-pastoral and crop-livestock systems of selected sites in Kenya and Ethiopia. Genetic response was compared between selection indexes with and without packed red blood cell volume (PCV) as measurement of tolerance for the disease with higher percentage indicating higher tolerance level. Selection index (SI) I without PCV used two traits, milk yield (MY) and live weight (LW) compared to selection index II including PCV additionally.

According to the findings in the field (Narok district, Kenya) the following population structure for pastoralists was assumed in this study: Number of cows is 200 over 10 age-groups with a replacement of 20 cows each year. The mating ratio of sire is 1:10 with 2 sires for each age-group. With a survival rate of 80%, 160 offspring is produced per year.

Genetic parameters used for the calculations and genetic responses were: Phenotypic standard deviation for MY, LW and PCV of 35kg, 7.4kg, 2.92% and heritabilities of 0.23, 0.30, 0.26, respectively. Phenotypic correlations between the traits were 0.15, -0.05 and 0.0, and genetic correlations were 0.01, -0.01 and 0.0.

The SI II increases MY by only 0.14kg per year compared to SI I with 2.40kg but changes PCV by 7.02% compared to a negative change of -0.02% if PCV is not included in the index. Both SI reduce live weight slightly by 0.01 and 0.02

for SI II and SI I respectively. Although the increase in production level for SI II is not as high as for SI I, the increase in tolerance is considerable and might lead to a better survival rate and save costs under African environmental conditions.

**Key Words:** Trypanotolerance, Selection Index, Breeding Objective

**W115 Using the n-alkane technique to estimate the herbage intake of steers grazing *Zoysia japonica* grassland.** Y. Zhang<sup>\*1</sup>, Y. Togamura<sup>2</sup>, and K. Otsuki<sup>2</sup>, <sup>1</sup>China Agricultural University, Beijing, PR China, <sup>2</sup>National Institute of Livestock and Grassland Science, Tochigi, Japan.

The alkane technique was evaluated for estimating herbage intake of grazing steers in a natural *Zoysia japonica* grassland in Japan. Six steers continuously grazed *Z. japonica* grassland in which species coverage was measured to be 78.8% *Z. japonica*, 13.5% eastern bracken (*Pteridium aquilinum*), 6.2% other plants and 1.5% bare area by point method. The steers were dosed with a controlled release device (CRD) capsule (Captec TM, New Zealand) for the estimation of herbage intake. Fecal samples were collected once daily from the ground immediately after defecation. Over the same period, herbage samples were hand plucked. Steer BW was measured before and after the 15-d experi-

mental period. Herbage and fecal samples were kept at -20°, freeze-dried, and milled through a 1 mm sieve. Concentrations of n-alkanes were determined by gas chromatography. Herbage intake was calculated using both the C{31}/C{32} and the C{33}/C{32} alkane pairs, based on the whole diet and fecal concentrations of these alkanes, and the C{32} release rate from the alkane-CRD. The effects of steers and alkane pairs (C{31}/C{32} or C{33}/C{32}) on intake were tested by Analysis of Variance using a completely random design. Relationships between steer BW changes and intakes were investigated by correlation. Herbage intake calculated by alkane technique was 1.6% to 2.4% of BW. Intake estimates based on either C{31} or C{33} alkanes did not differ ( $P > 0.05$ ). Estimated intake of *Z. japonica* differed significantly between steers ( $P < 0.05$ ), and was related significantly ( $P < 0.05$ ) to the changes of steer BW ( $r = 0.583$  and  $0.651$  for intake calculated by C{31}/C{32} and C{33}/C{32}, respectively). Herbage intake estimates were reasonable for the explanation for the BW changes according to the Japanese Feeding Standard for Beef Cattle. We conclude that herbage intake of steers grazing (*Zoysia japonica* grassland was estimated successfully with alkane technique.

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**Key Words:** Steers, Intake, Grazing

## Lactation Biology

**W116 Udder morphology and milking characteristics in dairy goats milked once- or twice-daily.** A. A. K. Salama<sup>1</sup>, G. Caja<sup>\*1</sup>, M. Rovai<sup>1</sup>, R. Casals<sup>1</sup>, and A. Martí<sup>2</sup>, <sup>1</sup>Universitat Autònoma de Barcelona, Bellaterra, Spain, <sup>2</sup>Universidad Miguel Hernández de Elche, Orihuela, Spain.

The effect of once- (1x) vs. twice- (2x) daily milking on udder morphology and milk emission during machine milking (42 kPa, 90 pulses/min) was studied in multiparous Murciano-Granadina dairy goats. Kids were removed from their mothers at birth and the goats milked 2x until the end of wk 2 when they were assigned to the milking frequency treatments: 1x (0900; n = 8), and 2x (0900 and 1700; n = 8) throughout lactation. Main udder and teat traits were measured 7 h after the a.m. milking at wk 2, 20 and 28 of lactation. Milk emission was recorded for each udder half during the a.m. milking on two consecutive days at wk 14 and 23 of lactation. Compared to 2x, 1x goats tended to have greater udder volume (1.67 vs. 1.53 L;  $P < 0.14$ ) and udder depth (18.3 vs. 17.5 cm;  $P < 0.06$ ). No differences were detected for teat traits. Stage of lactation affected ( $P < 0.01$ ) all morphological traits studied when wk 2 and 28 were compared (udder: volume, 1.86 and 1.28 L; depth, 19.7 and 17.4 cm; teat: angle, 41 and 29°; length, 27 and 30 mm; floor distance, 25.3 and 26.2 cm). Interaction between week of lactation and milking frequency was only detected for teat length, where teats become longer as lactation advanced in 2x. All goats gave milk emission curves with a long plateau indicating a sustained high milk flow during machine milking. Peak (680 ml/min) and average (403 ml/min) milk flow rates did not vary according to milking frequency treatment and stage of lactation (wk 14 and 23). Udder halves of 1x goats yielded a greater volume of machine milk (560 vs. 365 ml;  $P < 0.05$ ) and needed longer milking time (83 vs. 58 s;  $P < 0.05$ ) than 2x goats. Machine milk and milking time decreased as lactation advanced, but differences between wk 14 and 23 were only significant for 2x goats (412 and 317 ml; 65 and 51 s, respectively). Results showed morphological udder changes in order to adapt milk storage capacity to milk yield according to stage of lactation and milking interval. On the contrary, milk flow did not vary according to the amount of milk stored, suggesting that teat sphincter features more than intramammary pressure condition milk flow in goats.

**Key Words:** Milking Frequency, Milk Flow, Udder Traits

**W117 Effects of milking frequency prepartum on postpartum milk production, milk composition and dry matter intake in dairy cows.** R. R. Rastani<sup>\*1</sup>, N. Silva del Rio<sup>1</sup>, T. F. Gressley<sup>1</sup>, G. E. Dahl<sup>2</sup>, and R. R. Grummer<sup>1</sup>, <sup>1</sup>University of Wisconsin, Madison, <sup>2</sup>University of Illinois, Urbana.

Forty-eight Holstein cows were utilized in a randomized block design to evaluate different dry period lengths and prepartum milking frequency on subsequent milk production, milk composition and dry matter intake. Lactating cows began the experiment 35 d prior to expected calving date, were milked 2x/d during a 7 d covariate period and were assigned to one of three treatments. Cows were milked 0x/d (0x), 1x/d (1x), and 4x/d (4x) for the last 28 d of gestation. If milk production decreased to less than 0.5 kg/milking or 1 kg/d, milking via machine ceased; however, teat stimulation continued 1x/d or 4x/d according to treatment assignment. All cows were milked 2x/d postpartum (wk 1 to 8). Prepartum DMI tended to be greater for 1x and 4x compared with 0x ( $P < 0.10$ ). Prepartum, cows milked 1x produced 17% less than cows milked 4x (5.9 and 7.1 kg/d, respectively). There were no differences in prepartum and postpartum BCS and BW, and postpartum DMI. There was a parity by treatment interaction for postpartum milk production ( $P < 0.05$ ). Postpartum milk production by multiparous cows through 56 days in milk was greater for 0x/d and 4x/d compared with 1x/d (44.6, 44.6, and 34.6 kg/d, respectively;  $P < 0.02$ ). Postpartum milk production by primiparous cows was significantly decreased with increased milking frequency (39.8, 33.9, and 30.2 kg/d for 0x/d, 1x/d, and 4x/d;  $P < 0.01$ ). Postpartum fat yield was greater for 0x compared with 1x and 4x (1.51 vs. 1.32 and 1.21 kg/d;  $P < 0.01$ ). Postpartum protein yield tended to be greater for 0x compared with 1x and 4x (1.28 vs. 1.17 and 1.13 kg/d;  $P < 0.10$ ). Continuous milking resulted in a loss of milk production in the subsequent early lactation with primiparous cows; however, increasing milking frequency to 4x/d in the last 28 days of gestation eliminated the previously observed loss in milk production associated with continuous milking for multiparous cows.

**Key Words:** Dry Period Length, Continuous Milking, Milking Frequency

**W118 Mid term lactational effects of once- versus twice-daily milking in Manchega and Lacaune dairy ewes.** V. Castillo<sup>\*</sup>, X. Such, G. Caja, E. Albanell, and R. Casals, *Universitat Autònoma de Barcelona, Bellaterra, Spain.*

The effects of once- (x1) vs. twice-daily (x2) milking, throughout the milking period (wk 6 to 22) on milk yield, milk composition and somatic cell count