

The best combinations to calculate TDN were those assuming 0%, 6% h-1, and 0.75 ($r^2 = 0.48$, mean square error or prediction (MSEP) = 3.83%) and 10%, 8%, 0.75 ($r^2 = 0.48$, MSEP = 3.65) for IDNDF, kp, and kdNDF; respectively. Because a kp of 8% h-1 was assumed to be too fast to be effective for grazing cattle, the combination with kp of 6%/h was selected. A mixed model analysis indicated no differences among

months ($P = 0.08$) and seasons ($P = 0.39$; year as random). Temperature, relative humidity, and rain had weak correlation with TDN. The TDN distribution was lognormal with a 90% confidence interval between 40.7 and 55.5%. The lack of correlations was likely due to large variation and small sample size.

Key Words: evaluation, forage, fermentation

Graduate Student Paper Competition-CSAS Poster Competition: CSAS Graduate Student Competition 1

M114 Variation in antibody and cell-mediated immune responses between Canadian Holsteins and Norwegian-Red crossbred first calf heifers. S. Cartwright^{*1}, E. B. Burnside³, N. Karrow², L. Schaeffer², and B. A. Mallard¹, ¹University of Guelph Department of Pathobiology, Guelph, Ontario, Canada, ²Centre for Genetic Improvement of Livestock, Guelph, Ontario, Canada, ³Gencor Inc., Guelph, Ontario, Canada.

Inbreeding in the Holstein (HF) population has been steadily increasing and is thought to contribute to reduced fertility, decreased production and increased disease occurrence. The problems associated with inbreeding may be resolved by crossbreeding with more robust breeds. Previous research has shown superior udder health and reproductive efficiency of the Norwegian Red (NR) breed. The objective of this study was to evaluate antibody (AMIR) and cell-mediated immune response (CMIR) as well as production and differential cell count data on purebred and crossbred (HF, $n=50$; NR \times HF, $n=50$) first calf heifers. Therefore heifers were immunized 6-9 days post-calving using type-1 and type-2 test antigens. Sera were obtained on days 0 and 7 for antibody detection using ELISA. On day 7, background skin-fold measurements were taken of the tail-fold and intradermal injections of PBS (control) and test antigen were administered. Forty-eight hours later any increase in skin-fold measurements were taken to assess delayed type hypersensitivity (DTH) as an indicator of CMIR. Whole blood samples were taken on day 7 for differential cell count analysis. Data on production was obtained from Dairy Comp 305. A SAS general linear model that includes the effects of breed, month and herd will be used to determine any statistical significance in AMIR, CMIR, and production or cell counts between breeds. Preliminary results show crossbreds (least squares mean = 78.24%) had a significantly greater DTH response compared to purebreds (least squares mean = 50.56%) ($p = 0.0474$). However there was no significant difference between crossbreds (least squares mean = 1.10 OD) and purebred (least squares mean = 1.16 OD) for antibody response ($p = 0.7830$). These results suggest crossbreds have a greater cell-mediated immune response compared to purebreds and therefore enhanced defence against intra-cellular pathogens.

Key Words: immune response, purebred, crossbred

M115 Translation efficiency mediated by untranslated region of bovine beta casein mRNA. J. Kim^{*}, M. Bakovic, J. Li, J. Bag, and J. P. Cant, University of Guelph, Guelph, Ontario, Canada.

Regulation of protein translation in milk secretory cells of the mammary glands may influence milk protein production. It is generally accepted that untranslated regions (UTR) of mRNA play an active role in determining translational efficiency. Some of the characteristics of UTR involved in regulation of gene expression include secondary structure, length, and GC content. We hypothesized that the milk protein transla-

tion efficiency is influenced by characteristics of the 5' and 3' UTRs. The objectives were to test this hypothesis with *in vitro* translation assays, and to identify characteristics of 5' and 3' UTR of β -casein. Total RNA extracted from mammary gland of a Holstein dairy cow was first reverse transcribed to cDNA using oligo(dT), followed by 5' and 3' RACE-PCR to obtain the complete sequence of β -casein mRNA. Using different pairs of gene-specific primers, various recombinant transcripts spanning fragments of 5' and/or 3' UTR with the entire β -casein coding region were constructed. The amplified products were cloned into a pTZ19R vector to add a regulatory element sequence required for *in vitro* transcription and subsequent translation in rabbit reticulocyte lysate. Efficiency of translation was indexed as incorporation of biotinylated lysine residues into nascent β -casein which was detected by chemiluminescence. The quantity of extracted RNA from 100 mg of mammary gland was 884.7 ng/ μ l. The quality of RNA was illustrated by stained 28S and 18S ribosomal RNAs as well as the 260/280 and 260/230 ratios, both within the range of 2~2.05. The complete sequence of β -casein mRNA obtained by RACE-PCR was identified as 1095 bp in length where its 5' and 3' UTRs were 61 bp and 359 bp long respectively. Each of various recombinant transcripts incorporated in the pTZ19R vector were successfully transcribed and translated *in vitro* at optimal reaction times of 60 min and 40 min, respectively. The identification of sites on the UTR of mRNA of a milk protein that are responsible for translation efficiency improves our understanding of the mechanisms of translational control of milk protein.

Key Words: UTR, beta casein, translation efficiency

M116 Impact of an extended photoperiod in farrowing houses on sow and litter performances. M.-P. Lachance^{*1}, J.-P. Laforest², N. Devillers¹, A. Laperrière³, and C. Farmer¹, ¹Agriculture and Agri-Food Canada, Dairy and Swine R & D Centre, Sherbrooke, QC, Canada, ²Animal Science Dept., Laval University, Québec, QC, Canada, ³LTE, Hydro-Québec's Research Institute, Shawinigan, QC, Canada.

The current project studied the effect of an extended photoperiod around parturition and throughout lactation on the performance of sows and piglets. Fifty-four sows were assigned to two light regimens: 1) standard (CTL, $n = 28$) consisting of 8 h of light daily from d 112 of gestation until d 23 of lactation; 2) extended (TRT, $n = 26$) consisting of 23 h of light from d 112 of gestation to d 4 of lactation and 16 h thereafter. On d 4 and 21 of lactation, (between 1000 and 1115), milk samples were obtained for compositional analyses and blood samples were collected to measure prolactin and melatonin. Feed intakes were noted during lactation for sows and during the 35 d following weaning for piglets. Colostrum intake was estimated based on a 24 h piglet weight gain starting at the end of farrowing. Litter size was standardized to 10 ± 1 pigs. Piglets were weighed at birth and on d 2, 4, 7, 14, 21 (weaning), 35 and 56. Behavior of sows was recorded using scan sampling every

5 min for 24 h on d 3 and 19 of lactation. Behavior data were analyzed with the Wilcoxon test and all other data with PROC MIXED of SAS, according to a one-way factorial design. TRT sows had lower concentrations of melatonin on d 4 of lactation (6.76 vs. 9.51, SEM = 0.88 pg/mL, $P < 0.05$) but prolactin concentrations, milk composition, piglet colostrum intake and sow feed intakes were not affected by treatment ($P > 0.1$). Litter growth during lactation was also unaffected ($P > 0.1$) but TRT piglets consumed less feed in the 2 weeks after weaning ($P < 0.05$) and weighed less on d 35 ($P < 0.05$) than CTL piglets. CTL sows tended to spend more time standing up than TRT sows on d 19 of lactation ($P < 0.1$). In conclusion, increasing the light period in farrowing houses did not lead to beneficial effects on sow and litter performances. *Thanks to Hydro-Québec and the Québec Federation of Swine Producers for financial support.*

Key Words: photoperiod, sows, lactation

M117 Effects of low-voltage electrical stimulation and aging on heavy lamb meat tenderness. E. Pouliot^{*1}, C. Gariépy², M. Thériault^{1,3}, C. Avezard², J. Fortin², N. J. Simmons⁴, and F. W. Castonguay^{1,3}, ¹Université Laval, Québec, QC, Canada, ²Food Research and Development Centre, AAFC, St-Hyacinthe, QC, Canada, ³Dairy and Swine Research and Development Centre, AAFC, Lennoxville, QC, Canada, ⁴Carne Technologies Ltd, Cambridge, New Zealand.

Chilling is a post-slaughter process that can affect meat quality. In some instances, chilling of lamb carcasses in Quebec might be too fast, potentially causing muscle shortening, hence toughening of the meat. The aim of this study was to evaluate the effect of electrical stimulation (ES) and aging time on meat tenderness of heavy lamb in Quebec. Seventy-six Suffolk-sired crossbred male lambs were slaughtered at a target weight of 48-52 kg. Half of them were electrically stimulated at 5 min *post-mortem* (21 V; 0.25 A; 60 sec; Jarvis, Model ES-4, Middletown, CT, USA). During the first 24 h of chilling, temperature and pH fall were monitored in the *longissimus dorsi* (LD) and samples were taken for enzymes analyses. After carcass cutting, LD sections were randomly assigned to aging periods of 1, 3 or 8 d. Ultimate pH (48 h), Warner Bratzler shear force (WBSF), sarcomere length, myofibrillar fragmentation index (MFI), calpains and calpastatin activities and sensory evaluation were also carried out on the samples. Data were analysed using the MIXED procedure of SAS (2001). Temperature fall was the same for both treatments, however ES carcasses always had a lower pre-rigor pH value than controls ($P < 0.001$) while the ultimate pH was equivalent. Tenderness was enhanced both by ES ($P < 0.001$) and aging ($P < 0.001$) according to WBSF and sensory evaluation. At each aging time, tenderness was greater for ES meat and only 3 d of aging was necessary to achieve the same tenderness level as the controls at 8 d. Sarcomeres were longer ($P < 0.001$) in ES samples than in controls. Neither MFI nor calpains and calpastatin activities were affected by ES treatment. These results provide the first evidence that ES could enhance the tenderness of heavy lambs in Quebec, mostly through cold shortening reduction.

Key Words: electrical stimulation, tenderness, lamb meat

M118 Lysine and energy maintenance requirements in modern, high productivity sows are greater than previous estimates. R. S. Samuel^{*1}, S. Moehn¹, P. B. Pencharz², and R. O. Ball^{1,2}, ¹Swine Research and Technology Centre, University of Alberta, Edmonton,

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Selective breeding of sows may have affected maintenance requirements due to increased lean tissue and decreased lipid content in the whole body. The objectives of exp. 1 and 2, respectively, were to determine the maintenance energy (ME_m) and lysine (LYS) requirements of modern sows. Exp. 1: non-pregnant sows (n=5, 174 kg±11 kg) were fed a barley-wheat-SBM diet of 12.5 MJ ME/kg, 0.65% total lysine, and 15% crude protein for one week at about 1.0 ME_m (473 kJ/BW^{0.75}) and 2.0 ME_m (925 kJ/BW^{0.75}). Heat production was measured by indirect calorimetry for 24 h. Sows fed 1.0 ME_m deposited protein but lost body lipid and body weight (BW). When fed at 2.0 ME_m, sows gained 1292 g/d. The calculated ME_m at 1.0 ME_m and 2.0 ME_m (515±8 vs. 495±9 kJ/BW^{0.75}) were similar ($P=0.15$), with a mean value of 506±7 kJ/BW^{0.75}. Exp 2: non-pregnant sows (n=4; 222.6±0.7 kg BW) were adapted to 2.2 kg of a semi-synthetic diet containing 14.0 MJ ME/kg and 1.09 g/kg LYS. Each sow received 6 test diets in random order, providing LYS intakes of 19.8, 25.2, 30.6, 41.4, 46.8 and 52.2 mg/kg^{0.75}. After adaptation to each diet, indicator amino acid oxidation using L-[1-¹³C]-phenylalanine (PHE) was determined simultaneously with indirect calorimetry for 4 h. Plateaus in oxidation were achieved within 1.5 h. PHE oxidation decreased as LYS intake increased and was lowest ($P<0.05$) at 46.8 mg/kg^{0.75} LYS. Maintenance LYS requirement, calculated by regression analysis, was 49 mg/kg^{0.75}. Heat production was linearly correlated ($r^2 = 0.54$) with PHE oxidation and was lowest ($P<0.05$) at LYS intake of 46.8 mg/kg^{0.75}. The mean respiratory quotient (1.029±0.028) showed that dietary energy was not limiting. Energy and LYS maintenance requirements of modern sows were 10% and 30% greater than previously reported. Sows were energetically most efficient when fed to meet the LYS requirement. Requirements for energy and protein in modern, high productivity sows require further characterization.

Key Words: maintenance, energy, lysine

M119 A modified Ovsynch protocol using pLH or hCG in lactating dairy cows. M. B. Gordon^{*1}, R. Rajamahendran¹, M. G. Colazo², and D. J. Ambrose^{2,3}, ¹Department of Animal Science, Faculty of Land Food Systems, University of British Columbia, Vancouver, BC, Canada, ²Dairy Research and Technology Centre, Alberta Agriculture and Rural Development, Edmonton, AB, Canada, ³University of Alberta, Edmonton, AB, Canada.

The Ovsynch program for timed insemination (TAI) is commonly used by dairy producers as a reproductive management tool because it allows for the control of ovarian follicular and corpus luteum development without the need for estrus detection. However, some studies have reported that pregnancy losses occur at a higher rate after timed insemination using a GnRH-based Ovsynch protocol, than after insemination at detected estrus, in dairy cattle. Endogenous levels of progesterone and estrogen in plasma have been shown to have an inhibiting affect on LH release from the pituitary gland when treated with exogenous GnRH. This study compared the effects of 100 µg of Fertiline (GnRH) versus 25 mg of Lutropin-V (pLH), or 1,000 USP units of Chorulon (hCG) on ovarian response, conception rate and embryonic losses in lactating dairy cows subjected to a timed insemination protocol. Lactating Holstein cows were assigned to 3 treatment groups. Group 1 (n=57) received Ovsynch protocol with two treatments of GnRH 9 days apart with a treatment of PGF2α 48 hours before the second GnRH treatment and TAI 16-18 h later. Groups 2 (n=57) and 3 (n=53) received LH or hCG in place of the GnRH treatments, respectively. Pregnancy was diagnosed at 42 ± 3 d post-TAI. No differences in pregnancy rates were observed

between groups (28.1%, 22.6%, 22.8% for the GnRH, pLH, and hCG groups, respectively). Parity, DIM at TAI, and BCS had no effect on PR. Presumptive embryonic loss between days 28 and 42 was 16.7%, 9.3% and 8.3% for GnRH, pLH, and hCG groups, respectively ($P=0.43$). Animals were presumed pregnant on day 28 post-TAI if progesterone concentrations were > 1 ng/mL on days 14, 21, 25, and 28 post-TAI. Although this study did not find any advantages of replacing GnRH with pLH or hCG in a modified Ovsynch protocol, the number animals was small. As well, understanding the follicular and luteal patterns of animals treated with pLH or hCG during the modified Ovsynch protocol may also be important.

Key Words: Ovsynch, pLH, hCG

M120 Dairy farm sustainability in Quebec, Canada: The social aspect. V. Bélanger*, D. Parent, A. Vanasse, G. Allard, and D. Pellerin, *FSAA, Université Laval, Québec, Canada.*

Over the last two decades, the number of dairy farms has declined and the viability of the family farm and their rural communities has been questioned. To be sustainable, a farm should be viable, liveable, transmissible, and ecologically reproducible. Thus the assessment of farm sustainability should always be based on its economic, environmental and social aspects. As part of a comprehensive research project on the assessment of Quebec dairy farm sustainability, our objective was to develop indicators to evaluate the social aspect of farm sustainability; a concept rarely accounted for in the literature. To identify these indicators, experts (researchers, farmers, stakeholders) were consulted using a modified Delphi method. Our method uses a qualitative sequential approach: each expert submits his own indicators which are later debated in a focus group; the chosen indicators are then classified, ranked and, for each indicator, different threshold levels are established by the group to determine a score value for each. Indicators are selected based on their sensitivity to describe the social aspect of dairy farm sustainability considering the availability and easiness of on-farm acquisition. From the 166 statements initially submitted by the experts, 30 were selected and debated in the focus group. The relative weight of each indicator in a component and of each component remained to be determined by the focus group. To define the social aspect of dairy farm sustainability, indicators are grouped in four components for a total of 100 points: quality of life, social integration, farm succession and entrepreneurial skills. Results are presented as a radar diagram for each farm with axis representing indicators; for example, we have axis for farmer education level, leadership, innovativeness and risk-taking that describe the entrepreneurial skills component. This new assessment tool serves to evaluate the sustainability of a farm at a given point in time and could be used periodically to follow its evolution over the years.

Key Words: sustainability, social indicators, farms

M121 Characterization of rumen epithelial structure and function in lambs fed rapidly fermentable carbohydrates. M. A. Steele*, S. Greenwood, S. E. Hook, O. AlZahal, and B. W. McBride, *University of Guelph, Guelph, Ontario, Canada.*

The rumen epithelium performs vital roles in the absorption and metabolism of organic acids, yet very little is known about how it may adapt to compensate for shifts in rapidly fermentable dietary carbohydrates. Therefore, the objective of this study was to characterize the effect of increasing the proportion of rapidly fermentable dietary carbohydrates

on rumen epithelial histology, ultrastructure and ketogenesis. Rideau-Arcott lambs ($n=8$) were randomly divided into a complete block design and assigned to a control (CON) diet consisting of 29% mixed grain and 71% alfalfa pellets (as-fed), or a high-grain (HG) diet comprised of a maximum carbohydrate challenge of 79% mixed grain and 21% alfalfa pellets (as-fed). The HG lambs were transitioned to their diet in a step-wise manner over 12 days and blood plasma was collected every third day, while rumen tissue was collected at slaughter on day 13. Plasma BHBA levels were significantly higher ($P<0.01$) in HG lambs compared to CON lambs once the dietary grain level reached 60% (as-fed). In spite of elevated levels of plasma ketones, the mRNA expression of two key enzymes involved in the metabolism of organic acids to BHBA (HMG-CoA Synthase and Acyl-CoA Synthase) were not differentially expressed between the CON and HG. Analysis of rumen tissue collected at slaughter by scanning electron and light microscopy revealed structural damage to the strata granulosum and corneum in the HG lambs but not the CON. To further investigate structural alterations, the mRNA expression of Desmoglein1, an important component of desmosomes, was quantified. Interestingly, the mRNA expression of Desmoglein1 was decreased 10-fold ($P<0.05$) in HG lambs which corresponds to the histological observation of demarcation in the exterior strata. The results from this study demonstrate that rumen epithelial ketone body production and structural integrity can be quickly altered by increasing the quantity of rapidly fermentable carbohydrates in the diet.

Key Words: rumen epithelium, ketogenesis, gene expression

M122 The influence of fish oil diets on insulin metabolism in adult male pig. C. A. Castellano*^{1,2}, I. Audet¹, J. -P. Laforest², P. Y. Chouinard², and J. J. Matte¹, ¹Dairy & Swine R & D Centre, Agriculture and Agri-Food Canada, Sherbrooke, Qc, Canada, ²Department of Animal Sciences, Québec city, Qc, Canada.

The aim of this study was to evaluate the effects of long term dietary supplementation of n-3 polyunsaturated fatty acids (n-3 PUFAs) on plasma fatty acid profile, body weight (BW) and back fat thickness (P2) as well as on glucose, insulin and C-peptide responses to an oral glucose tolerance test in adult male pigs. Fifteen Duroc boars aged of 204.5 ± 1.8 days (145.8 ± 3.3 kg BW) received daily 2.5 kg of basal diet with a supplement of: 1) 62 g of hydrogenated animal fat (C, $n=5$); 2) 60 g of menhaden oil containing 17% of docosahexaenoic acid (DHA) and 15% of eicosapentanoic acid (EPA) (M, $n=6$) and 3) 60 g of tuna oil containing 30% of DHA and 7% of EPA (T, $n=4$). Rations were balanced to be isocaloric. After 7 months of experiment, a catheter was fit in the jugular vein and repeated blood samples were collected during 6 h following the oral glucose bolus (1 g/kg BW). Data were analysed using MIXED and CORR procedures of SAS. Data were considered significant at $P<0.05$. There were no difference among treatments for BW (275.4 ± 2.8 kg, $P=0.07$) and P2 (17.7 ± 1.1 mm, $P=0.20$). Dietary supplementation with n-3 PUFAs altered blood plasma profile: DHA and EPA increased whereas arachidonic acid decreased ($P<0.01$). Following the glucose tolerance test, plasma glucose, insulin and C-peptide were not affected by treatments ($P>0.34$). For all animals, correlations were found between P2 and C-peptide (an indicator of insulin secretion) ($r=+0.50$) and between P2 and glucose/insulin ratio (an indicator of insulin sensitivity) ($r=-0.54$). In conclusion, long term supplementation with dietary n-3 PUFAs did not affect insulin metabolism in healthy adult pig. The relationship between body fat and insulin sensitivity, well documented in human, suggests that adult male pig could be a promising animal model for studies on insulin metabolism.

Key Words: pig, fish oil, insulin