

Growth and Development I

M178 Net requirements of calcium and phosphorus for gain of Nellore and Nellore x *Bos taurus* crossbreds. M. P. Gionbelli*¹, M. I. Marcondes^{1,3}, S. C. Valadares Filho^{1,3}, L. F. Prados¹, and M. L. Chizzotti², ¹Universidade Federal de Viçosa, Viçosa, MG, Brazil, ²Universidade Federal de Lavras, Lavras, MG, Brazil, ³Instituto Nacional de Ciência e Tecnologia - Ciência Animal, Brazil.

This study aimed to understand and estimate net requirements of calcium (Ca) and phosphorus (P) for gain of Nellore and crossbred Nellore x *B. taurus* cattle. A database containing 283 animals from 11 comparative slaughter studies was used. There were 190 Nellore and 93 Nellore x *B. taurus*, being 99 intact males, 115 steers, and 69 heifers. Allometric and quadratic regression models were used to describe the relationship between Ca and P in the equivalent EBW (EQEBW, kg). It was also determined the point at which there was no more significant addition of these mineral in the EQEBW by the linear plateau method. This represents the point at which the net requirements of these minerals for gain are considered equal to zero. Allometric and quadratic equation allowed equal adjustments, although quadratic equation represents better the biological deposition of Ca and P. There was a linear reduction in the net requirement of Ca and P per unit of gain due to the increase of animal weight (Table 1). The plateaus of deposition of Ca and P were observed at 413 kg of EQEBW (470 and 497 kg of SBW for Nellore and Crossbred, respectively) for Ca and 412 kg of EQEBW (468 and 495 kg of SBW for Nellore and Crossbred, respectively) for P. Therefore, utilization of a common plateau for Ca and P at 412 kg of EQEBW is suggested. The effects of gender and genetic group were not tested, however the breed impact seems to be well controlled, given that the EQEBW adjusts the degree of maturity. We conclude that the net requirements for Ca and P in Nellore and Crossbred decrease with the increase of BW and reaches zero with 412 kg of EQEBW. Acknowledgment: Sponsored by INCT-Ciência Animal, Brazil.

Table 1. Allometric and quadratic equations and net requirements for Ca and P for Nellore and Crossbred cattle

Mineral	Model	Equation
Calcium	Allometric	$Ca_{EBW} \text{ (kg)} = 0.17 \times EQEBW^{0.60}$
		$NRG_{Ca} \text{ (g)} = EBG \times (102 \times EQEBW^{-0.40})$
	Quadratic	$Ca_{EBW} \text{ (Kg)} = 0.2 + 0.024 \times EQEBW - 0.0000225 \times EQEBW^2$
Phosphorus	Allometric	$NRG_{Ca} \text{ (g)} = EBG \times (24 - 0.045 \times EQEBW)$
		$P_{EBW} \text{ (kg)} = 0.042 \times EQEBW^{0.71}$
	Quadratic	$NRG_p \text{ (g)} = EBG \times (29.8 \times EQEBW^{-0.29})$
		$P_{EBW} \text{ (Kg)} = -0.3 + 0.013 \times EQEBW - 0.0000119 \times EQEBW^2$
		$NRG_p \text{ (g)} = EBG \times (13 - 0.0238 \times EQEBW)$

Key words: allometric, quadratic, beef

M179 Effects of maternal body condition and breeding season forage type on beef heifer growth. J. D. Patterson*¹, M. L. Loooper², B. C. Williamson¹, and C. F. Rosenkrans¹, ¹University of Arkansas, Fayetteville, ²USDA/ARS DBSFR, Booneville, AR.

Gestational malnutrition of the dam may affect postnatal growth of offspring. Our objective was to determine effects of forage type grazed during conception and body condition (BC) during pregnancy of cows on heifer growth. Brahman-influenced cows (n = 40; BCS = 5.9 ± 0.1) were assigned to graze either common bermudagrass (CB) or toxic tall fescue (E+) during a 60-d breeding season; BC was assessed at d 0, 30,

and 60 of the breeding season. Cows were classified into 1 of 2 BCS change categories: gain/maintain (n = 22 cows; mean gain = 0.8 BCS units) or lose (n = 18 cows; mean loss = 1.1 BCS units) BC during the first 2 trimesters of pregnancy. Cows were managed to achieve marginal (BCS = 4.3 ± 0.8) or good (BCS = 6.3 ± 0.8) BC during the last trimester. Birth weight of heifers was recorded. During development, heifers were equally assigned to CB or E+ and weaning weight (WW), hip height (HH), hip width (HW), pelvic height (PH), pelvic width (PW), and pelvic area (PA) were measured at 9 to 10 mo of age. Influence of forage, BC, and BC change on heifer growth was determined by ANOVA. Cows grazing E+ had heifers weighing less ($P < 0.01$) at birth (32.7 ± 0.8 kg) compared with heifers from cows grazing CB (35.6 ± 0.6 kg). Change in BC of cows during the first 2 trimesters did not influence ($P > 0.10$) birth weight, WW, HW, PH, PW or PA; HH tended ($P = 0.12$) to be increased in heifers (117 ± 1 cm) from cows losing BC during the first 2 trimesters compared with heifers (115 ± 1 cm) from cows gaining BC. Heifers (244 ± 7 kg) from cows in good BC tended ($P < 0.10$) to have heavier WW than heifers (228 ± 7 kg) from cows in marginal BC during the last trimester. Actual BCS of cows during the last trimester was correlated ($P < 0.05$) with birth weight (r = 0.34), WW (r = 0.40), HW (r = 0.38), and tended ($P < 0.10$) to be correlated with heifer HH (r = 0.27). Consumption of toxic tall fescue during breeding may reduce birth weight of subsequent offspring. Further, BC loss in cows late in gestation can decrease WW of their calves. Improper nutrition during conception, gestation, or both may impact postnatal growth.

Key words: beef cow, body condition, postnatal growth

M180 Effects of colostrum intake and pre-weaning nutrient intake on post-weaning feed efficiency and voluntary feed intake. F. Soberon* and M. E. Van Amburgh, Cornell University, Ithaca, NY.

Non-nutritional factors in colostrum have long been recognized as valuable for the development of the newborn calf, however, the benefits of colostrum intake surpass those related to the immune system. We hypothesized that some of the non-nutritional factors in colostrum as well as the nutrient availability during the pre-weaning period have permanent effects on feeding behavior or efficiency of nutrient utilization. Calves were fed either 2 L (n = 19) or 4 L (n = 32) of pooled colostrum, within 1 h of birth. Calves receiving 4 L of colostrum were fed another 2 L of colostrum 12 h after the first feeding while the calves fed 2 L were fed 2 L of milk replacer (MR, 28% CP, 15% fat, Excelerate, MSC). Plasma IgG content was determined for all calves 24 to 48 h after the first colostrum feeding. After the second feeding, all calves were fed MR by an automated feeder (Förster-Technik). Half of the calves on each colostrum treatment were allowed to consume 4 L/d of MR while the other half were allowed to consume up to 12 L/d and intake was recorded by the feeders. Calves had access to a calf starter. All calves were weaned at 52 d and offered the same ration and DMI was recorded daily for 1 mo post weaning. All calves had plasma IgG concentrations above 12 mg/mL. Treatment comparisons were made using the mixed procedures of SAS and significance was determined at $P < 0.05$. Calves fed 4 L MR had similar ADG pre-weaning regardless of colostrum (0.35 ± 0.04 kg/d, $P = 0.56$). However, calves offered 12 L/d MR demonstrated greater ADG when they had 4 L of colostrum at birth (0.78 kg/d vs. 0.55 kg/d, $P < 0.01$). Also, during the post-weaning period, calves fed 4 L colostrum had greater DMI than calves receiving 2 L of colostrum independent of previous MR intake (2.8 vs. 2.2 kg/d;

$P = 0.01$). Calves that received 4 L of colostrum also had greater feed efficiency regardless of MR treatment (0.38 vs. 0.32 kg gain/kg DM, $P = 0.02$). We concluded that some non-nutritional components of colostrum are altering metabolic programming responsible for regulating appetite and nutrient utilization in calves.

Key words: colostrum, feed efficiency, appetite

M181 Interactions of residual feed intake and other performance parameters of Japanese Black (Wagyu) bulls. M. McGee*¹, C. M. Welch¹, J. B. Hall², and W. Small³, ¹University of Idaho, Moscow, ²University of Idaho Nancy M. Cummings Research, Education, and Extension Center, Carmen, ³AgriBeef Snake River Farms, American Falls, ID.

Wagyu cattle are unique due to a propensity for accumulation of extraordinary levels of intramuscular fat as animals mature. Unfortunately, the Wagyu breed exhibits slow growth and poor feed efficiency. Objectives of the present study were to characterize these performance parameters, to accumulate data describing performance of Wagyu cattle, and to improve growth and feed efficiency while simultaneously optimizing marbling. Ninety-two yearling Wagyu and Wagyu cross bulls were evaluated for residual feed intake (RFI) and other performance variables during a 70-d RFI test. Individual daily feed intake (GrowSafe, Alberta, Canada) and BW gain (BW measured at the beginning and end of test and at 2-wk intervals) were recorded. During the test period, bulls were fed a corn-based TMR (1.90 Mcal/kg NEM, 1.25 Mcal/kg NEg, 15.05% CP) formulated to match the nutritional equivalent of the diet fed to finishing Wagyu cattle. The RFI was positively correlated with DMI ($r = 0.56$; $P < 0.0001$) and F:G ratio ($r = 0.49$; $P < 0.0001$) but was not correlated with ADG, metabolic BW, ultrasound REA, or ultrasound rib fat. There was a tendency toward a favorable correlation between RFI and IMF ($r = -0.17$; $P = 0.11$). To facilitate further analysis, bulls were classified into RFI groups as efficient ($n = 32$), marginal ($n = 34$), and inefficient ($n = 26$), based on deviations from the mean RFI value. The RFI groups exhibited differences in F:G ratio ($P = 0.003$), and DMI ($P < 0.0001$), but there were no differences for metabolic BW, ADG, or ultrasound estimates of IMF, REA, and rib fat. The inefficient group had greater DMI ($P < 0.0001$) and F:G ratio ($P = 0.0003$) than the efficient group. The marginal group also had greater DMI ($P < 0.0001$) than the efficient group. This phenotypic evaluation of Wagyu bulls provides an indication that RFI is related to other measures of intake and feed efficiency, however does not influence growth and carcass performance. It is expected that accumulation of these data as greater numbers of bulls are characterized will facilitate simultaneous improvements in feed efficiency, BW gain, and optimized marbling in Wagyu cattle.

Key words: Wagyu, residual feed intake, efficiency

M182 Feeding or passive transfer of Anti-IL-10 peptide antibodies suppresses growth and feed efficiency in chicks. J. M. Sand*, J. Abazi, T. Fullmer, and M. E. Cook, University of Wisconsin-Madison, Madison.

Previous work from our lab showed that feeding antibody to the pro-inflammatory protein secretory phospholipase A2 (sPLA2) increased chick growth and feed efficiency (Cook ME, 2004 J. Appl. Poult. Res. 13:106–119). Here we attempt to suppress chick growth rate and or feed efficiency using an antibody to chicken interleukin-10 (IL-10), a cytokine responsible for downregulation of inflammatory processes. Egg antibody directed against 4 hydrophilic, antigenic, and accessi-

ble peptides of IL-10 were produced in Single Comb White Leghorn laying hens and measured using ELISA. Egg yolks were collected and lyophilized; the yolk powder was then added to feed at 3.41 g/kg feed to determine chick response. Treatment differences were determined using a 2-sided *t*-test. Anti-IL-10 peptide 4 (EPTCLHFS) suppressed growth in a study of mixed-sex chicks 6% (20/treatment, $P = 0.03$) whereas anti-IL-10 peptide 3 (EKMDENGI) decreased feed efficiency 3% in a study of mixed-sex chicks (35/treatment, $P = 0.069$). Hens producing the anti-IL-10 antibodies were artificially inseminated and chicks were hatched to determine the effects of passive transfer of anti-IL-10 peptides on growth and response to a lipopolysaccharide (LPS) challenge. Day-old mixed-sex chicks from hens producing any anti-IL-10 peptide antibodies (25 chicks/group) were smaller than chicks from adjuvant-injected controls (23 chicks) (3.4 to 9%, $P < 0.05$). Weight gain was reduced approximately 7% in chicks from hens injected with peptides 3 and 4 ($P = 0.08$). Chicks with passive anti-peptide 2 (VLPRAMQT) and anti-peptide 4 had reduced weight following LPS injection compared with saline-injected controls ($P = 0.05$). In summary, the feeding or passive transfer of antibody to specific peptides on chicken IL-10 reduced the rate of gain and may serve as a host targeted model for mimicking immune regulation of growth.

Key words: interleukin-10, inflammation, growth

M183 Empty body composition of Nellore bulls classified for residual feed intake. E. F. M. Bonilha¹, F. L. Araújo², S. F. M. Bonilha*¹, and R. H. Branco¹, ¹Instituto de Zootecnia, Sertãozinho, São Paulo, Brazil, ²Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil.

Residual feed intake (RFI) is an efficiency measure calculated as the difference between DMI observed and estimated based on metabolic BW and ADG. High RFI animals (less efficient) consume more than expected to a certain ADG, while the low RFI ones (more efficient) consume less than expected. This study aimed to evaluate empty body composition (EBC) of Nellore bulls classified in divergent levels of RFI. The experiment was conducted at Instituto de Zootecnia, Sertãozinho/São Paulo/Brazil, with 33 Nellore bulls, which were previously evaluated for RFI. From 60 evaluated bulls, 15 were classified as low RFI (\leq mean + 0.5 SD) and 18 as high RFI (\geq mean + 0.5 SD). Animals were slaughtered when they reached the minimum of 4 mm of subcutaneous fat thickness, with an average of 399 kg for BW and 18 mo for age. The EBC was obtained after grinding, homogenizing, sampling, analyzing, and combining blood, hide, head, feet, viscera, and carcass. Empty body percentages of water, ether extract (EE), protein, and ash were determined. Data were analyzed by GLM of SAS and means were compared by Tukey test at 5% of probability. There was no significant difference ($P = 0.9526$) in empty BW, showing that low and high RFI animals had similar body sizes. No significant differences were detected for empty body percentages of water ($P = 0.1266$), EE ($P = 0.6663$), protein ($P = 0.2800$), and ash ($P = 0.4627$), showing that low RFI animals (more efficient), for the same body composition, had a lesser feed intake, which contributes to the system economic viability.

Table 1. Means of empty BW, percentages of water, EE, protein, and ash in Nellore bulls from divergent levels of RFI

	Low RFI	High RFI	CV (%)	P-value
n	15	18	—	—
EBW, kg	367	366	12.5	0.9526
Water, %	63.9	63.1	2.39	0.1266
EE, %	13.6	14.0	15.5	0.6663
Protein, %	17.7	18.3	8.66	0.2800
Ash, %	4.76	4.67	7.69	0.4627

Key words: feed efficiency, body fat, body water

M184 Body and carcass fat of Nellore bulls classified for residual feed intake. S. F. M. Bonilha¹, R. H. Branco¹, K. Zorzi², M. E. Z. Mercadante¹, J. N. S. G. Cyrillo¹, and L. A. Figueiredo¹, ¹Instituto de Zootecnia, Sertãozinho, São Paulo, Brazil, ²Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil.

Efficiency of food utilization is directly related to production system profitability, because food is the major cost in intensive beef production. Residual feed intake (RFI), expressed as the difference between DM intakes observed and estimated by a regression equation as a function of metabolic BW and ADG, is a measure of feed efficiency and can be a tool to reduce beef production costs. The study objective was to evaluate differences in body and carcass fat of Nellore bulls from low (\leq mean - 0.5 SD; n = 32) and high (\geq mean + 0.5 SD; n = 27) RFI levels. The experiment was conducted at Instituto de Zootecnia - Sertãozinho/São Paulo/Brazil, with 59 Nellore bulls finished in individual pens until they reach 4 mm of subcutaneous fat thickness (FT), assessed by ultrasound in LM, and slaughtered with averages of 447 kg for BW and 20 mo for age. The KPH was collected and weighed and FT was measured at 11th rib of LM. A steak sample of LM, with 2.5 cm of thickness, was removed from 11th rib for LM ether extract (LMEE) determination on a DM basis. Data were analyzed using GLM procedure of SAS, and means were compared using *t* test. The RFI variation was 0.740 kg of DM/d, with averages of -0.330 ± 0.034 and 0.410 ± 0.037 kg, respectively, for low and high RFI animals. No differences were detected between low and high RFI animals for slaughter BW (442 ± 11.1 and 454 ± 12.1 kg; $P = 0.4615$) and HCW (271 ± 7.30 and 279 ± 7.95 kg; $P = 0.4608$), respectively, showing that more and less efficient animals had similar body sizes. For KPH, FT, and LMEE, no significant differences were found between low and high RFI animals. The KPH averages were 8.88 ± 0.596 and 9.72 ± 0.649 kg ($P = 0.3447$); FT averages were 4.29 ± 0.281 and 4.37 ± 0.306 mm ($P = 0.8413$); and LMEE averages were 40.8 ± 1.24 and $39.7 \pm 1.35\%$ ($P = 0.5463$), respectively for low and high RFI animals, showing that more and less efficient animals had similar body and carcass fat content.

Key words: beef cattle, fat thickness, feed efficiency

M185 Describing DMI and growth patterns in beef steers during the finishing period. N. Vargas Jurado¹, G. Scaglia², W. S. Swecker¹, D. A. Fiske¹, J. P. S. Neel³, J. P. Fontenot¹, and R. M. Lewis¹, ¹Virginia Tech, Blacksburg, VA, ²Louisiana State University, Iberia Research Station, Jeanerette, ³USDA-ARS, Beaver, WV.

Feed intake is central to animal production systems, as it impacts efficiency and represents a substantial fraction of the total costs. The objectives of this study were to: (i) assess feed intake, weight gain, and feed efficiency in Angus crossbred steers during finishing on a total mixed diet; and, (ii) describe the pattern of their growth using the

Brody function. The experiment was conducted at a research farm in western Virginia. Feed intake and BW data were collected on 18, 22, and 11 steers in 2005, 2006, and 2007, respectively. Animals were on average 420 d of age, and weighed 357 kg, when housed in a drylot with access to an individual feeding system (Calan Gate System, American Calan, NH). Across years, steers were fed a similar diet (9.7% CP and 15.6% NDF DM) ad libitum for 90 to 128 d. Daily feed intake (DFI), ADG, and feed conversion ratio (FCR) were evaluated. In addition, mature size (*A*), daily rate of growth (*k*), and initial BW at the start of the study (W_0), were estimated by fitting the Brody function $W_t = A - ((A - W_0) \cdot \exp(-kt))$, where W_t is weight at time *t*. Mean DFI were 15.4 ± 0.1 , 16.6 ± 0.1 , and 17.6 ± 0.1 kg/d, for 2005, 2006, and 2007, respectively, with significant differences among years ($P < 0.001$). Growth rate was constant (linear) over the finishing period ($P < 0.001$; $R^2 = 0.93$). The mean ADG in 2006 (1.25 ± 0.09 kg/d) was less ($P < 0.01$) than in 2005 (1.66 ± 0.07 kg/d) and 2007 (1.53 ± 0.13 kg/d). Mean FCR was better ($P < 0.01$) in 2005 (10.0 ± 0.4) than in 2006 (13.1 ± 0.7), with 2007 intermediate (12.1 ± 1.1). The estimates of *A* and *k*, the 2 key parameters of the Brody function, were similar across years: *A* was 742 ± 158 , 734 ± 298 , and 730 ± 269 kg while *k* was 0.0065 ± 0.0041 , 0.0065 ± 0.0110 , and $0.0072 \pm 0.0092/d$, for 2005, 2006, and 2007, respectively. The correlation between *A* and *k* was -0.99 , indicating a strong relationship between their estimated values. Differences in intake, ADG, and FCR were observed among years although cattle genotype and husbandry were similar. Even with those differences, the Brody function appeared to provide a useful general description of growth in steers during the finishing period.

Key words: Brody function, cattle, feed intake

M186 Effects of heat stress on proliferation, protein turnover, and levels of heat shock protein mRNAs in cultured porcine muscle satellite cells. E. Kamanga-Sollo, M. Pampusch, M. White, M. Hathaway*, and W. Dayton, University of Minnesota, St. Paul.

It is well established that heat stress (HS) negatively impacts growth rate in swine. Although reduced feed intake undoubtedly plays a significant role in this reduction, studies in laboratory animals and other non-swine species indicate muscle growth also is affected by heat-stress-related alterations in muscle physiology. Heat shock proteins (Hsp) may play an important role in regulating rate and efficiency of muscle growth. The effects of HS on rates of satellite cell proliferation, protein synthesis, and protein degradation may play an important role in determining the rate and extent of muscle growth. We have examined the effects of mild HS (40.5°C for 48 h) on rates of proliferation (³H-thymidine incorporation rate), protein synthesis (³H-phenylalanine incorporation), and protein degradation (³H-phenylalanine release from pre-labeled cultures) and on levels of Hsp90, Hsp70, and Hsp25/27 mRNA (qRT-PCR) and protein in cultured porcine muscle satellite cells (PSC). Data were analyzed using the mixed procedure of SAS. When significant interactions were detected ($P < 0.05$), least squares means were separated using LSD tests. Mild HS of PSC cultures resulted in 2.5-, 1.4-, and 6.5-fold increases ($P < 0.05$) in the levels of Hsp90, Hsp70, and Hsp25/27 mRNAs, respectively, relative to the levels in control cultures. Levels of Hsp 90, 70, and 25/27 proteins were also increased in HS PSC cultures compared with those in control cultures. Proliferation rates in HS PSC cultures were 35% lower ($P < 0.05$) than those in control cultures. Protein synthesis rates in HS fused PSC cultures were 85% higher ($P < 0.05$) than in control cultures and protein degradation rates in HS fused PSC were 23% lower ($P < 0.05$) than in control cultures. In light of the crucial role satellite cells play in postnatal muscle growth, the HS-induced changes

we have observed in rates of proliferation, protein turnover, and in levels of Hsp mRNA and protein in PSC cultures indicate that mild HS affects the physiology of PSC in ways that could affect muscle growth in swine.

Key words: porcine, satellite cell, heat stress

M187 Effects of increased protein and energy fed in milk replacer and heat stress on growth parameters of neonatal Holstein bull calves. A. J. Krenek*¹, G. A. Holub¹, T. A. Tomaszewski¹, and C. C. Stanley², ¹Texas A&M University, College Station, ²Land O Lakes Purina Feed, Amarillo, TX.

The objective was to evaluate if calves fed 6 L of milk replacer with higher protein levels (HPMR; 1135 g/d, 28% CP, 20% fat) had improved performance compared with calves fed 4 L of a conventional milk replacer (CMR; 454 g/d, 20% CP, 20% fat) in heat stress and non-heat stress environments. Holstein bull calves ($n = 52$) < 3 d of age were assigned to a 2 X 2 factorial trial based on initial BW, physical health score, and total serum protein levels to either a heat stress (HS) or non-heat stress environment (NHS), with one half of each environment receiving HPMR and the other half receiving CMR. The study was conducted for 56 d from June 19 to August 13, 2010. The average thermal heat index (THI) was calculated for each day by averaging the 24 recorded temperatures and % relative humidity. The 56-d average, low, and high range THI for the HS were 79, 67, and 86 respectively, while THI for the NHS were 69, 66, and 74 respectively. Weekly measurements of BW, body length (BL), hip width (HW), wither height (WH), heart girth (HG), and hip height (HH) were measured and ADG and average daily change were calculated. Water consumption (WC) and starter intake (SI) were measured daily. Data were analyzed using Proc Mixed of SAS 9.2. Calves on HPMR had a greater ($P < 0.01$) WH, HG, BL, HH, and ADG than the CMR calves (1.81 VS. 1.28 ± 0.004), (0.20 vs. 0.14 ± 0.009), (0.27 vs. 0.22 ± 0.01), (0.37 vs. 0.28 ± 0.008), and (0.82 vs. 0.58 ± 0.04) respectively. Calves in HS had a greater ($P < 0.01$) WC than the NHS calves (4365.56 vs. 2526.97 ± 102.2), respectively. The HPMR calves also had a greater WC ($P < 0.01$) than the CMR calves (4235.6 vs. 2656.96 ± 102.2), respectively. The CMR calves had a greater SI ($P < 0.05$) than HPMR calves (942.38 vs. 435.99 ± 0.39), respectively. There was no significant difference in growth parameters in HS or NHS in calves of like feeding strategies. The increased amount of protein and energy fed in the HPMR treatment did have an effect on WH, HG, HH, BL, WC, SI, and ADG.

Key words: calf, milk replacer, heat stress

M188 Indirect methods for estimation BW of crossbreed Holstein-Jersey heifers. B. C. Matos*, C. M. M. Bittar, W. R. S. Mattos, and L. F. Silveira, University of São Paulo, University of Sao Paulo, USP/ESALQ, Piracicaba, SP, Brazil.

This study's aim was to develop an estimation equation of BW on prepubertal Holstein-Jersey heifers from measures of growth parameters, and to compare them with the values obtained by mechanic scale and classical prediction equations described in the literature. Biweekly, 12 heifers of ~90 d of age were evaluated for BW, withers height (WH), hip width (HW), and heart girth (HG). The measures were taken until the animals attained 280 to 300 kg of BW. Regression analyses to estimate BW from measurements of growth parameters were developed using Proc Reg of SAS (1999). Regression analysis estimates and classical prediction equations were also used to estimate BW of heifers

of different ages. Analysis of variance of estimated and mechanical scale data was performed using Proc GLM of SAS, with the average values compared by the Tukey test, and significance level of 5%. The measurement of HG presented the best coefficient of determination (R^2) with BW values. Linear regression resulted in lower R^2 values, especially for WH and HW. There were no statistical effects ($P > 0.05$) for the estimation measure. However, significance was found for age and interaction of age and estimation measure ($P < 0.001$). For the age range of 3 to 5.9 mo only WH linear regression overestimated the values of BW ($P < 0.05$). During the period of 6 to 7.9 mo the linear regressions of WH, HG, and HW overestimated the BW in relation of those found on a mechanical scale ($P < 0.05$). Estimating BW by classical prediction equations numerically underestimated the BW values as compared with the scale values. For the age range from 11 to 13 mo, WH and HW linear regression underestimated the BW of dairy heifers. Use of HG, WH, and HW measurements and classical prediction equations for BW estimation of crossbred dairy heifers was efficient, indicating that use of these measures, in lieu of a mechanical scale, may support improvements in on-farm management of nutrition and reproduction.

Key words: estimate method, growth, growth parameter

M189 Effects of rice or wheat straw as ingredients in a TMR on Holstein heifer growth. R. E. Rauch*^{1,2}, G. A. Nader², P. H. Robinson², and L. J. Erasmus¹, ¹University of Pretoria, Pretoria, South Africa, ²University of California, Davis.

Rice straw (RS) is not common in dairy heifer rations, partly due to its low NE value and tough physical properties. To compare 2 RS harvesting methods (sickle chop or slicer baled), 5 dairies received ~12 t of each and a survey was conducted to compare dairyman experiences. The best RS (slicer baled) was used in a Latin square study with 2 treatments (i.e., RS- and wheat straw (WS)-based diets, both at 18% DM), 2 periods of 28 d and 4 pens of ~180 Holstein heifers each (age 14 to 18 mo) to compare effects on DMI, digestibility, BCS, and growth. The general linear model (GLM) procedure of SAS was used for statistical analyses. The RS heifers had a lower DMI (9.5 vs. 11.1 kg/d, $P < 0.01$) but greater ($P < 0.01$) digestibility of DM (57.8 vs. 52.4%), CP (57.6 vs. 54.5%), fat (82.2 vs. 78.4%), and ADF (40.4 vs. 36.9%, $P = 0.01$). The RS had lower intakes of digestible DM, aNDFom (amylase-treated ash-free NDF), and fat (5.5 vs. 6.0 kg/d, $P = 0.09$; 2.16 vs. 2.41 kg/d, $P = 0.04$; 0.26 vs. 0.28 kg/d, $P = 0.0497$, respectively). Change in BCS, tailhead height (TH), and hip width (HW) was lower for RS than WS (-0.0141 vs. +0.008 units/30 d, $P < 0.01$; 0.44 vs. 1.28 cm/30 d, $P < 0.01$ and 0.68 vs. 1.63 cm/30 d, $P = 0.01$, respectively). A heifer frame score (HFS) was developed to create a 2-dimensional measure of skeletal growth while removing effects of BCS change on HW, as: $HFS = \text{corrected HW} \times TH$, where: corrected HW (mm) = $HW - BCS \text{ correction} (BCSc)$, and $BCSc \text{ (mm)} = (3.2 \times BCS) + (0.8 \times \text{age in mo}) - 6.09$. The $BCSc$ was determined using a calliper to measure pin bone skin and fat thickness. The RS heifers had lower HFS change (3.82 vs. 8.46 cm²/30 d, $P < 0.01$) and calculated NE output (i.e., NE_M , growth based on HFS, BCS loss/gain, and fetal growth), and diet NE concentration than WS (10.5 vs. 13.5 Mcal/d, $P < 0.01$; 1.10 vs. 1.21 Mcal/kg DM, $P = 0.049$, respectively). Lower feed efficiency with RS may be due to increased rumen retention time and fermentation energy loss (e.g., methane), a difference in DCAD for WS and RS diets (264.9 vs. 319.9 mEq (Na⁺K⁺Cl⁻S)/kg), or compensatory growth of WS heifers, as they had been fed a RS diet before the study.

Key words: rice straw, wheat straw, heifer growth

M190 Effects of pre-weaning nutrient intake in the developing mammary parenchymal tissue and fat pad. F. Soberon* and M. E. Van Amburgh, *Cornell University, Ithaca, NY.*

The mammary gland is considered to grow at an isometric rate during the first 2 mo of life followed by an allometric rate until peri-puberty. Multiple reports describe an association between growth rate before puberty and altered mammary gland development, primarily due to an increase in the size of the fat pad while parenchymal growth is restricted. Twelve dairy heifer calves were fed either a constant amount of a 28% CP 15% fat milk replacer (MR) per day equivalent to 0.18 Mcal intake energy/kg BW^{0.75} (Control, n = 6) or 0.3 Mcal intake energy/kg BW^{0.75} (Enhanced, n = 6). All calves had full access to water and calf starter. Calves were harvested at 54 ± 2 d. The Control group consumed 32.6 kg of MR and 6.7 kg of calf starter and the Enhanced group consumed 69.5 kg of MR and 1.9 kg of calf starter. Initial and final BW for the Control and Enhanced treatments were 39.2, 61.0, 39.7, and 83.2 kg, respectively. At harvest, weights of liver, kidneys, pancreas, whole skinned mammary gland, and mammary parenchyma were measured. Growth rate was calculated for each organ as the change in organ weight as a percentage of BW. Treatment comparisons were made using the mixed procedures of SAS and significance declared at *P* < 0.05. The mammary glands with Enhanced treatment were heavier at harvest (*P* < 0.01) and when calculated as %BW, resulted in 4x greater parenchymal growth. We conclude that in early life, the mammary gland is responsive to nutrient intake and this differs from post-weaning mammary growth responses. Based on differences in nutrient supply, allometric growth was initiated pre-weaning. Understanding which cells are responding to nutrient supply may aid in understanding the effect of early life nutrient intake on future milk production.

Table 1.

	Control	Enhanced	SE	<i>P</i> -value
ADG (kg/d)	0.39	0.82	0.03	<0.01
Pancreas (g)	32.90	29.47	4.39	0.61
Pancreas, %BW	0.06	0.04	0.01	0.11
Liver (kg)	1.35	2.35	0.82	<0.01
Liver, %BW	2.23	2.84	0.09	<0.01
Kidney (g)	183.60	319.72	33.29	0.02
Kidney, %BW	0.30	0.38	0.03	0.09
Whole mammary (g)	75.48	337.58	29.14	<0.01
Mammary gland, %BW	0.12	0.41	0.03	<0.01
Parenchyma (g)	1.10	6.48	1.00	<0.01
Parenchyma, % of gland	1.35	1.90	0.37	0.30
Parenchyma, %BW	0.002	0.008	0.001	<0.01

Key words: mammary gland, growth

M191 Effect of diet metabolizable protein:metabolizable energy ratio on growth parameters and mammary gland development of crossbred Holstein-Jersey heifers reared on an accelerated growth program. B. C. Matos*, C. M. M. Bittar, W. R. S. Mattos, G. B. Mourao, and L. F. Silveira, *University of Sao Paulo, USP/ESALQ, Piracicaba, SP, Brazil.*

The aim of this trial was to evaluate the effect of metabolizable protein:metabolizable energy (MP:ME) ratio in diets based on tropical grasses and concentrate composed of by-products formulated for

high growth rate during the prepubertal phase on growth parameters and mammary gland development of Holstein-Jersey heifers. Twelve heifers (90 d of age) were housed in individual pens, with free access of water and shade. Heifers were allocated to control (MP:ME = 39 g/Mcal) and high MP:ME ratio (MP:ME = 44.5 g/Mcal), according to a completely randomized statistical design. Biweekly, heifers were weighed on a mechanical scale until BW had attained between 280 and 300 kg, the expected weight of puberty. Measures of withers height (WH), hip width (HW), and heart girth (HG) were also taken. Monthly, size and length of teats were measured, and blood samples were collected for progesterone analysis. Heifers were considered pubertal when levels of progesterone were > 1.0 ng/mL. The MP:ME ratios observed were higher than those first predicted by NRC (2001), with values of 44.39 and 52.98 g/Mcal, respectively for control and high MP:ME treatment. The average value of DMI was 5.3 ± 1.8 kg DM/d with no effect of diet (*P* < 0.05). Body weight, HW, HG, and WH increased during the experiment (*P* < 0.05) and were not influenced by treatment. Measures of mammary gland development increased (*P* < 0.05) during the experimental period however no statistical effect of diet was found. The age at puberty of treatments occurred at 10.6 and 11.4 mo, respectively for high MP:ME and control; no effect of diet was observed. Measurement of growth parameters and mammary gland development were not influenced by diet MP:ME ratio. Increasing values were a result of animal growth. Formulating diets for prepubertal dairy heifers based on MP:ME requirements is efficient because it minimizes the occurrence of protein deficiency, which might occur in growing heifers, especially in mammary and skeletal tissues.

Key words: growth parameter, puberty, heifer

M192 Milk diet affects glucose transporters in skeletal muscle of neonatal calves. U. Schönhusen, C. Rehfeldt, J. Steinhoff-Wagner, and H. M. Hammon*, *Leibniz Institute for Farm Animal Biology (FBN), Dummerstorf, Germany.*

Colostrum feeding improves glucose status in neonatal calves by stimulating intestinal glucose absorption. Elevated systemic glucose availability may also lead to an altered substrate flux between tissues. We have tested the hypothesis that gene and protein expression of facilitative glucose transporters GLUT1 and GLUT4 in skeletal muscle depends on milk diet. Calves were fed twice daily either colostrum (C; n = 7) or a milk-based formula with same nutrient density as colostrum, but no biologically active factors (F; n = 7). Amounts fed per meal were 4% of BW on d 1 and 5% of BW on d 2 to d 4. Nutrient and lactose contents of C and F were identical. On d 4, calves were slaughtered 2 h after feeding. Masseter (M), longissimus dorsi (LD) and semitendinosus (ST) muscles were removed for measurement of mRNA and protein expression of GLUT1 and GLUT4 by real-time PCR and SDS PAGE immunoblot, respectively. Muscles were classified as oxidative and glycolytic according to isocitrate dehydrogenase (ICDH) and lactate dehydrogenase (LDH) activities. Data were analyzed by the Mixed Model of SAS with diet, muscle, and diet × muscle interaction as fixed effects and individual calves as random effect. ICDH was highest (*P* < 0.001) and LDH was lowest (*P* < 0.001) in M; ICDH tended to be higher (*P* < 0.1) and LDH tended to be lower (*P* < 0.1) in ST than in LD. Protein expression of GLUT4 was highest (*P* < 0.001) in M and protein expression of GLUT1 was higher (*P* < 0.05) in LD than in M. For GLUT4, protein expression in M, LD, and ST tended to be higher (*P* < 0.1) in C than in F, whereas gene expression was lower (*P* < 0.05) in ST and tended to be lower (*P* < 0.1) in LD of C compared with F. Gene expression of GLUT1 in ST was higher (*P* < 0.05) in F

than in C. Elevated GLUT4 protein expression in C than in F is in line with previously shown higher postprandial plasma concentrations of insulin after colostrum feeding, probably resulting in a greater insulin-stimulated glucose uptake in oxidative as well as glycolytic muscles. The elevated mRNA expression of GLUT4 in glycolytic muscles of F

vs. C may point at a compensatory transcriptional response to lower protein expression.

Key words: calf, muscle, glucose transporter