

## Forages and Pastures: Forage Finishing

**441 Effects of forage species on fatty acid composition of beef longissimus muscle from forage-finished beef.** S. K. Duckett<sup>\*1</sup>, E. Pavan<sup>2</sup>, R. N. Sonon<sup>2</sup>, J. Neel<sup>3</sup>, J. P. Fontenot<sup>4</sup>, and W. Clapham<sup>3</sup>, <sup>1</sup>Clemson University, Clemson, SC, <sup>2</sup>University of Georgia, Athens, <sup>3</sup>USDA-ARS, Beaver, WV, <sup>4</sup>Virginia Tech, Blacksburg.

Forty-seven Angus-crossbred steers were used to evaluate the effects of forage species grazed in the last 41 d of the finishing period on rib composition, color, and palatability in forage-finished beef and compared to traditional high concentrate finished. Steers grazed naturalized pastures (bluegrass/white clover) for 93 d and then grazed alfalfa (AL; n = 12), pearl millet (PM; n = 12), or naturalized pastures (NP; n = 12) pastures for the final 41 d of finishing. Steers (n = 11) were also finished on a high concentrate diet (C) for 134 d. Data were analyzed with finishing treatment in the model. Total lipid content of longissimus muscle was 57% lower (P < 0.01) for forage-finished than C with no differences among forage species. Saturated fatty acid percentage was higher (P < 0.05) for AL than PM and C due to greater (P < 0.05) concentrations of stearic acid. Monounsaturated fatty acid percentage was higher (P < 0.05) for C than all forage-finished treatments indicating greater activity of delta-9 desaturase enzyme. Omega-6 fatty acid concentration did not differ among treatments. Omega-3 fatty acid concentration was higher (P < 0.05) for AL, PM and NA than C. Linolenic acid percentage was greater (P < 0.05) for AL than PM and NA, which were greater (P < 0.05) than C. The ratio of omega-6 to omega-3 fatty acids was lower (P < 0.05), hence more desirable from a human health standpoint, for forage-finished than C (1.32 vs. 6.37, respectively). Trans-11 vaccenic acid concentration was greater (P < 0.05) for forage-finished than C; whereas, trans-10 octadecenoic acid concentration was greater (P < 0.05) for C than forage-finished. The cis-9 trans-11 isomer of conjugated linoleic acid concentration was 150% greater (P < 0.05) for forage-finished than C. Overall, forage-finished beef was leaner and contained greater concentrations of desirable fatty acids compared to concentrate finished. However, only minor changes in fatty acid composition as related to finishing on different forage species were observed.

**Key Words:** Beef, Forage, Fatty acids

**442 Effects of forage species on rib composition, color, and palatability in forage-finished beef.** S. K. Duckett<sup>\*1</sup>, R. N. Sonon<sup>2</sup>, E. Pavan<sup>2</sup>, J. Neel<sup>3</sup>, J. P. Fontenot<sup>4</sup>, G. Scaglia<sup>4</sup>, and W. Clapham<sup>3</sup>, <sup>1</sup>Clemson University, Clemson, SC, <sup>2</sup>University of Georgia, Athens, <sup>3</sup>USDA-ARS, Beaver, WV, <sup>4</sup>Virginia Tech, Blacksburg, VA.

Forty-seven Angus-crossbred steers were used to evaluate the effects of forage species grazed in the last 41 d of the finishing period on rib composition, color, and palatability in forage-finished beef and compared to traditional high concentrate finished. Steers grazed naturalized pastures (bluegrass/white clover) for 93 d and then grazed alfalfa (AL; n = 12), pearl millet (PM; n = 12), or naturalized pastures (NP; n = 12), pasture for the final 41 d of finishing. Steers (n = 11) were also finished on traditional high concentrate diets (C) for 134 d. Data were analyzed with finishing treatment in the model. Hot carcass weight (HCW) was 99 kg heavier (P < 0.01) for C finished than NP, AL, and PM with no differences among forage types. Ultimate longissimus muscle pH was lower for C than PM or NP with AL being intermediate. Percentage total fat was 43% lower (P < 0.05) and percent fat-free lean was 17% greater for forage-finished than C in

the 9-10-11th rib section. No differences were detected in lean, fat and bone composition among forage species. Longissimus muscle color was darker (P < 0.05; lower L\* value) for forage-finished than C. Muscle color was also darker (P < 0.05) for PM than AL with NA being intermediate. Yellowness (b\*) of LMA was higher (P < 0.01) for C than NA or PM with AL being intermediate. Yellowness of s.c. fat was higher (P < 0.01) for forage-finished than C. Steak juiciness as rated by trained sensory panelist was highest (P < 0.01) for AL and lowest (P < 0.05) for C. Initial and overall tenderness scores were highest (P < 0.01) for AL. Panelists rated initial and overall tenderness lower (P < 0.01) for NP than PM with C being intermediate. Beef flavor intensity was greater (P < 0.01) and off-flavor intensity lower (P < 0.01) for C than F. Beef flavor intensity ranked higher (P < 0.01) and off-flavor intensity ranked lower (P < 0.05) for C than forage-finished treatments. Beef flavor intensity was higher (P < 0.05) for AL than NP with PM intermediate. No differences in off-flavor intensity among forage types were detected.

**Key Words:** Beef, Forage, Carcass

**443 Corn oil or corn grain supplementation to forage-finished steers. I. Effects on animal performance and carcass quality.** E. Pavan<sup>\*1,2</sup> and S. Duckett<sup>3</sup>, <sup>1</sup>University of Georgia, Athens, <sup>2</sup>INTA, Balcarce, Bs. As., Argentina, <sup>3</sup>Clemson University, Clemson, SC.

Twenty eight Angus (289 ± 3.8 kg) steers were used in a completely randomized design to evaluate the effect of isoenergetic supplementation of two different energy sources to steers rotationally grazing tall fescue pastures for 197 d. Steers were supplemented with either corn grain (0.52% BW; PC) or soybean hulls plus corn oil (0.45% BW + 0.10% corn oil; PO) using Calan gates for individual intake measurement. Negative (pasture only; P) and positive (85% concentrate/15% roughage; C) control diets were also included in the study to compare with the performance of the supplemented steers. Steers on PC, PO and P treatments were managed together under a rotational grazing system; whereas, C steers were maintained on an adjacent tall fescue pasture for the initial 105 d and then fed a high concentrate diet also using Calan gates. Data were analyzed using Mixed procedure of SAS; LS-means were separated using pdiff option. The ADG for PC and PO was higher (P < 0.01) than in P and lower (P < 0.01) than C. ADG tended (P = 0.09) to be greater for PC than PO during the first 105 d period but ADG did not differ among supplement sources during final 92 d or overall. Hot carcass weights for PO and PC were 36 kg greater (P < 0.01) than P and 67 kg lighter (P < 0.01) than C. However, efficiency of concentrate utilization (overall kg of gain above P/kg supplement or overall kg of gain/kg high concentrate intake) did not differ among energy supplement sources or compared to concentrate finished. Dressing percentage, s.c. fat thickness, KPH percentage and yield grade were lower (P < 0.01) for PO and PC than C and higher (P < 0.01) for PO than P. Only dressing percentage was higher for PC than P, for the other variables PC was similar (P > 0.05) to either P or PO. Marbling score, quality grade, and LMA were also lower (P < 0.01) in PO and PC than in C, but did not differ (P > 0.05) from P. Energy supplementation, regardless of energy source, to grazing steers increased performance and carcass weight but did not alter carcass quality.

**Key Words:** Beef, Pasture, Supplementation

**444 Corn oil or corn grain supplementation to forage-finished steers. II. Effects on s.c. and i.m. fatty acid composition.** E. Pavan<sup>\*1,2</sup> and S. Duckett<sup>3</sup>, <sup>1</sup>University of Georgia, Athens, <sup>2</sup>INTA, Balcarce, Bs. As., Argentina, <sup>3</sup>Clemson University, Clemson, SC.

Samples of s.c. and i.m. fat were obtained from 28 Angus steers after slaughter to determine the effect of energy supplementation of steers grazing tall fescue pastures. Steers ( $289 \pm 3.8$  kg) were supplemented with either corn grain (0.52% BW; PC) or soybean hulls plus corn oil (0.45% BW + 0.10% corn oil; PO). Negative (pasture only; P) and positive (85% concentrate/15% roughage; C) controls were also included in the study. Steers were slaughtered at similar time-on-feed endpoint. Fatty acid (FA) composition from the s.c. and i.m. were determined by GLC and analyzed with dietary treatment in the model by fat depot. Total fatty acid content of longissimus muscle was 55% greater ( $P < 0.01$ ) for C than PC, PO, or P. In i.m. fat, forage-finished beef contained lower ( $P < 0.01$ ) percentages of myristic and palmitic acids. Stearic acid concentration was greater ( $P < 0.01$ ) for PO than PC or P, which were greater ( $P < 0.01$ ) than C. Concentrations of trans-11 vaccenic acid (TVA) were increased ( $P < 0.01$ ) by 90% and 467% with PO compared to P and C, respectively. Conjugated linoleic acid (CLA; cis-9 trans-11) concentration was 24% and 217% greater ( $P < 0.01$ ) for PO than P and C, respectively. Omega-6 fatty acid concentration was greater ( $P < 0.01$ ) for PO than PC or P, which were greater ( $P < 0.01$ ) than C. Supplementation reduced ( $P < 0.01$ ) omega-3 fatty acid concentration compared to P but levels were greater ( $P < 0.01$ ) than C. In s.c. fat, PO reduced ( $P < 0.01$ ) palmitic acid percentages compared to PC and P; however, all forage-finished beef were lower ( $P < 0.01$ ) in palmitic acid than C. Oil supplementation increased ( $P < 0.01$ ) concentration of TVA and CLA by 71% and 27%, respectively, compared to P and by 629% and 443%, respectively, compared to C. PO had the highest ( $P < 0.01$ ) omega-6 fatty acid concentration and P the lowest ( $P < 0.01$ ). Oil supplementation lowered ( $P < 0.01$ ) omega-3 fatty acid concentration compared to P to levels of C. Oil supplementation to grazing steers reduced the level of atherogenic fatty acids and increased anticarcinogenic fatty acids in forage finished beef.

**Key Words:** Forage-finished beef, Supplementation, Fatty acid

**445 Corn oil or corn grain supplementation to forage-finished steers. III. Effects on longissimus pH, tenderness, and flavor.** E. Pavan<sup>\*1,2</sup> and S. Duckett<sup>3</sup>, <sup>1</sup>University of Georgia, Athens, <sup>2</sup>INTA, Balcarce, Bs. As., Argentina, <sup>3</sup>Clemson University, Clemson, SC.

Twenty eight Angus ( $289 \pm 3.8$  kg) steers were used in a completely randomized design to evaluate the effect of isoenergetic supplementation of two different energy sources to steers rotationally grazing tall fescue pastures for 197 d on meat quality. Steers were supplemented with either corn grain (0.52% BW; PC) or soybean hulls plus corn oil (0.45% BW + 0.10% corn oil; PO). Negative (pasture only; P) and positive (85% concentrate/15% roughage; C) control treatments were also included in the study to compare with the supplemented steers (S). Steers on C were maintained on an adjacent tall fescue pasture for the initial 105 d and then fed a high concentrate diet. At the end of the feeding period steers were slaughtered and carcass temperature and pH were determined during the first 24 h post-mortem. LM color was determined, samples obtained, and aged for a total of 1, 3, 7, 14 and 28 d for subsequent Warner-Bratzler shear force and trained sensory panel evaluation. Carcass temperature decline was slowest ( $P \leq 0.05$ ) in C than in PC, PO or P. LM pH at 3 h and 24 h postmortem was lower ( $P \leq 0.01$ ) for C than PC or P with PO being intermediate. LM lightness

was higher ( $P \leq 0.05$ ) for C than PO, PC, or P and was also higher ( $P \leq 0.01$ ) for PC and PO than P. Yellowness of s.c. fat was higher ( $P \leq 0.01$ ) for PO and PC than C or P, which did not differ. WBSF was lower ( $P \leq 0.05$ ) for C than for PC and P, with PO being intermediate. Trained sensory panel ratings for tenderness and beef-flavor intensity were higher ( $P \leq 0.05$ ) for C than for PC, PO, or P. Off-flavor scores were lower ( $P \leq 0.01$ ) for C than P with PC and PO being intermediate. Oil supplementation to forage-finished steers alters muscle pH, tenderness, color and off-flavors scores; the latter two variables are also affected by corn grain supplementation

**Key Words:** Beef, Tenderness, Pasture

**446 Dried distillers grains substitute for forage and nitrogen on pasture.** M. A. Greenquist\*, K. J. Vander Pol, L. Baleseng, T. J. Klopfenstein, W. H. Schacht, and G. E. Erickson, *University of Nebraska, Lincoln.*

Forty five yearling steers ( $349 \pm 10$  kg) were used in a randomized complete block to evaluate performance, nitrogen use, and economic impact of supplementation and management strategies on smooth bromegrass pastures. Yearling steers were stocked at 9.9 AUM/ha for smooth bromegrass pastures fertilized with 88 kg N/ha (CONT), non-fertilized smooth bromegrass pastures stocked 69% of the CONT (NOFERT), or non-fertilized smooth bromegrass pastures stocked at the same rate as the CONT with 2.3 kg (DM) of dried distillers grains with solubles (DDGS) supplemented daily (SUPP). Pastures were grazed from April 22 to September 19, 2005 and blocked by location. Pasture represented the experimental unit and was replicated three times. Pastures were strip-grazed at the assigned stocking rate for 4 d/strip (6 strips/cycle) in cycles 1 and 5 and for 6 d/strip in cycles 2, 3, and 4. Nitrogen accretion was estimated from weight gains using NRC (1996) equations. Steers on CONT gained the same as NOFERT ( $P=1.0$ , 0.62 kg/d and 0.62 kg/d for CONT and NOFERT, respectively) but had greater costs of gain (\$0.81/kg gain vs. \$0.65/kg gain) due to additional costs of N being greater than the additional cost of land use. Steers supplemented with DDGS gained more ( $P<0.01$ ) than CONT or NOFERT (0.89 kg/d vs. 0.62 kg/d). The cost of gain for SUPP steers was \$0.68/kg gain (DDGS was \$0.121/kg, delivered). Nitrogen accretion per ha for SUPP steers was 38.5% greater than CONT ( $P<0.01$ , 9.30 kg/ha vs. 6.72 kg/ha) and 99.6% ( $P<0.01$ , 9.30 kg/ha vs. 4.66 kg/ha) greater than NOFERT. Nitrogen use efficiency based on the amount of N applied as either fertilizer or in DDGS was 3.2 times greater for SUPP steers than CONT steers (26.38 % vs. 8.23%). Nitrogen accretion costs were \$0.23/kg N gain, \$0.30/kg N gain, and \$0.26/kg N gain for the NOFERT, CONT, and SUPP steers, respectively. Dried distillers grains can be used as a substitute for forage and N fertilizer by improving performance, reducing cost of gains, and reducing costs associated with N accretion in yearling steers.

**Key Words:** Dried distillers grains, Fertilizer, Forage

**447 Use of cuticular wax alkanes to estimate digestibility and intake of cows at pasture with a view to estimating efficiency.** S. W. Coleman\*, C. C. Chase, Jr., and D. G. Riley, *USDA ARS Subtropical Agricultural Research Station, Brooksville, FL.*

Determination of feed efficiency requires estimates of intake and digestibility of the diet, but they are difficult to measure on pasture. The objective of this research was to determine if plant cuticular alkanes were suitable as markers to estimate intake and diet digestibility of grazing cows with sufficient precision to determine differences among

breeds. Purebred Angus (A), Brahman (B) and Romosinuano (R) cows grazing Bahiagrass pastures, all nursing 2 to 3 mo old calves were used. External markers were administered to four cows of each breed using an intraruminal device that continuously delivered 320 mg of C32 and C36 daily. After 7 d for equilibration, forage and feces (10 samples/cow) were collected over the next 2 wk. All samples were lyophilized and ground to pass a 1 mm screen. Alkanes were extracted and analyzed by gas chromatography. Digestibility was calculated from the ratio of C31, C33, or C35 in the forage and feces. Ratios of C31/C32, C32/C33, and C35/C36 in feces were to quantify fecal output and intake as a proportion of body weight (BW). Digestibility and intake values were analyzed using a repeated measures model where animals were repeated measures over days using a compound symmetry covariance structure. Coefficients of variation (CV) in digestibility among animals were 2.44, 3.49, and 5.98 % for C31, C33, and C35, respectively, quite low and similar to pen fed measurements. Digestibility was different ( $P < 0.05$ ) among breeds when estimated with C31 (73, 75 and 73 %) or C35 (64, 63, and 59 %, for A, B and R cows, respectively). Estimates made with C33 approached significance ( $P = 0.055$ ) with estimates of 71, 71, and 68 % for A, B and R cows. Intake CVs were 27, 20, and 28 % for ratios of C31/C32, C32/C33, and C35/C36, respectively. Mean intakes were 53, 39, and 46 g/kg BW daily for the three alkanes, and were not different among breeds. Mean intake values appeared to be biased upward, possibly due to rather large adjustments for the amount of C32 (13.5 ppm) and C36 (24.6 ppm) in forage samples. Use of other forage species with lower amounts of C32 and C36 should improve estimates of intake. Estimates of intake and digestibility differed with different alkane pairs.

**Key Words:** Forage intake, Alkanes, Grazing

#### **448 Effect of grazing management on cattle distribution patterns.**

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Because of concern that grazing cattle may elevate nutrient and sediment loads in surface waters, a study was conducted to measure spatial and temporal distribution, defecation, and urination patterns of cattle managed by different stocking systems. Six 12.1-ha cool-season grass pastures were divided into 2 blocks and assigned one of three treatments; continuous stocking - unrestricted stream access (CSU), continuous stocking - restricted stream access (CSR), and rotational stocking (RS). Pastures were stocked with 15 fall-calving Angus cows (650 kg) from May to October 2005. Cow location and activity were recorded at 10 min intervals from 0600 to 1800 h on two consecutive days during 7 observation periods during the grazing season. Location was defined as within stream and 0 to 33.5 m, 33.5 to 67 m, and more than 67 m from the stream. Activities included the number of cattle present, urination, and defecation. The use of RS and CSR decreased ( $P < 0.05$ ) time cows spent in the stream and within 33.5 m of the stream and increased ( $P < 0.05$ ) time spent greater than 67 m from the stream compared to CSU. There was no effect of observation period or observation period  $\times$  treatment interaction on time cattle spent in the stream. Significant treatment by observation period interactions existed ( $P < 0.05$ ) for time cows spent 0 to 33.5 m from the stream. Cows managed by RS spent 46% of their time in the stream during the September 17 observation period while during other observation periods, cows in the RS pastures spent approximately 1% of their time in the stream. Cows in the CSU pastures spent more than 20% of their time from 0 to 33.5 m from the stream during the May 23 and September 17 observation periods and less ( $P < 0.05$ ) time during other observation periods. In CSR pastures cows spent approximately 1% of their time 0 to 33.5 m from the stream for all observation periods. Patterns of defecation and urination distribution followed that of cow distribution. Compared to CSU, RS and CSR are potential management strategies for decreasing negative impacts of cattle behavior on water quality.

**Key Words:** Grazing, Animal behavior

## **Goat Species: Improving Meat, Milk and Parasite Control in Goats**

**449 Indicators of fitness in Boer, Kiko, and Spanish does managed on pasture in Tennessee (Year 2).** R. Browning, Jr.\*, B. Donnelly, T. Payton, M. L. Leite-Browning, P. Pandya, W. Hendrixson, and M. Byars, *Tennessee State University - IAgER, Nashville.*

Boer (BR;  $n = 55$ ), Kiko (KK;  $n = 51$ ), and Spanish (SP;  $n = 50$ ) straightbred does representing a broad base of within-breed genetic lines were managed together on pasture from September 2004 to August 2005. Three-quarters of each breed were mated in October and the remainder bred in December. Herd health records were analyzed by GLM for the 2004-2005 production year to assess animal fitness under the prevailing production environment. Does were treated for hoof scald and hoof rot upon observed lameness. Breeds differed ( $P < 0.01$ ) for lameness cases treated during the year. Boer does required more ( $P < 0.01$ ) treatments for lameness ( $2.15 \pm 0.19$  cases/doe) than SP ( $0.80 \pm 0.2$  cases/doe) or KK ( $0.57 \pm 0.2$  cases/doe). A higher ( $P < 0.01$ ) frequency of BR required hoof treatments per year compared with SP or KK (86.9 vs. 37.7 and 36.9  $\pm$  6.2%, respectively). Does due to kid in March were dewormed with ivermectin as a group in February. All does were dewormed with moxidectin individually at parturition.

Individual does presenting clinical signs of internal parasitism during the year received extra anthelmintic treatments. Breeds differed ( $P < 0.01$ ) for extra anthelmintic treatments. Extra dewormings were more numerous for BR than for SP or KK (0.56 vs. 0.23 and  $0.13 \pm 0.08$  cases/doe, respectively). A higher ( $P < 0.01$ ) frequency of BR received extra dewormings during the year ( $43.1 \pm 5.5\%$ ) compared to SP ( $17.3 \pm 5.8\%$ ) or KK ( $13.1 \pm 5.7\%$ ). Fecal egg counts (FEC) were determined on a random subset of does (31 BR, 28 KK, 25 SP) across kidding groups near the weaning of kids at 3 mo of age (June and August). Breed affected ( $P < 0.01$ ) log-transformed FEC with values higher ( $P < 0.04$ ) for BR than for SP. Geometric mean FEC for BR, KK and SP were 419, 274, and 137 eggs/g, respectively. The proportion of does weaning kids and doe survival rate through the production year were lower ( $P < 0.01$ ) for BR does ( $67 \pm 5\%$ ,  $84 \pm 4\%$ ) than for KK ( $88 \pm 6\%$ ,  $98 \pm 4\%$ ), SP does were intermediate ( $82 \pm 6\%$ ,  $90 \pm 4\%$ ). Results mirror Year 1 and suggest differences among meat goat breeds for doe fitness under southeastern US conditions.

**Key Words:** Breed, Fitness, Meat goats