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G13-425 2013 Nebraska Beef Report Summaries

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2013 Nebraska Beef Report Summaries

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Brief synopses of recent UNL beef research.

Introduction

Each year the UNL Department of Animal Science reports its current beef cattle research. More detailed reports are available in the *2013 Nebraska Beef Report*, available in print from University of Nebraska–Lincoln Extension or on the Web at *http://www.ianrpubs.unl.edu/sendIt/mp98.pdf* or *http://beef.unl.edu.*

Cow/Calf

Effect of Beef Heifer Development System on ADG, Reproduction, and Feed Efficiency During First Pregnancy. Heifers were developed on dormant pasture and placed on grazed corn residue or in a drylot. The following winter, a subset of pregnant heifers were placed in a Calan Broadbent individual feeding system during late gestation. Drylot-developed heifers had greater BW from pre-breeding through pregnancy diagnosis and greater overall ADG during development. There was no difference in reproductive performance. Pre-calving BW, ADG, and G:F tended to be greater for drylot heifers. Heifers developed on corn residue had reduced BW but similar reproductive performance to drylot-developed heifers.

Effect of Development System on Heifer Performance and Primiparous Heifer Grazing Behavior. Weaned heifers grazing corn residue tended to have reduced final BW after corn residue grazing compared to heifers grazing winter range. However reproductive performance for the two treatments was similar. When grazing corn residue as pregnant heifers during late gestation, heifers developed on corn residue had improved ADG compared to drylot-developed heifers and tended to have increased ADG compared to winter range-developed heifers.

Heifers with Low Antral Follicle Counts Have Low Birth Weights and Produce Progeny with Low Birth Weights. High antral follicle count heifers had greater BW from birth through pre-breeding. Progeny birth BW was greater for calves born to high antral follicle count heifers. These data indicate a relationship between antral follicle counts and BW through the first breeding season and continues to support a possible link between genes that influence growth and development and establishment of ovarian reserve.

Effect of Two Estrus Synchronization Protocols on Reproductive Performance of May Calving Cows. The objective of this experiment was to determine the effectiveness of fixed-time AI utilizing CO-Synch or CO-Synch + CIDR. Cows synchronized with the CO-Synch + CIDR protocol had increased AI and overall pregnancy rates. CO-Synch + CIDR cows calved earlier.

Efficacy of Newborn Bovine DNA Samples Taken Via Different Mediums in Assigning Paternity. DNA samples from 25 newborn calves taken via hair, ear notch, and nasal swabs were used to determine the efficacy of sampling method in assigning parentage. Nasal swab collection time did not result in significant differences in the ability to assign the correct sire. Clean nasal swab samples are comparable in efficacy to hair and ear notch samples in assigning parentage.

Growing

Effect of Winter Supplementation Level on Yearling System Profitability. Calves backgrounded in a forage-based system at a high winter supplementation level maintained a performance advantage through finishing. High level supplemented cattle gained an additional 0.2 lb daily during finishing, consumed less total feed in the feedlot, required fewer days on feed to reach a common finish point and produced an additional 85 lb of saleable live weight compared to cattle backgrounded at a low supplementation level. High level supplemented cattle returned $56.01 more than cattle fed a low level of supplementation.

Applying Corn Condensed Distillers Solubles to Hay Windrows Prior to Baling: I. Procedure and Effects on Bale Temperature and Nutrient Composition. Two experiments investigated the effects of applying liquid corn condensed distillers solubles to grass-hay windrows prior to baling. Increased CP and decreased NDF for hay treated with corn condensed distillers solubles indicates successful within-bale storage.

Applying Corn Condensed Distillers Solubles to Hay Windrows Prior to Baling: II. Effects on Growing Cattle Performance. Two experiments evaluated the feeding value of grass hay bales previously treated with CCDS in growing cattle diets. In Experiment 1, heifers fed bales treated with 20% CCDS (DM) gained less than those fed an equal level of dried distillers grains plus solubles and nontreated hay. In Experiment 2, ADG and F:G linearly improved with increasing CCDS levels. Supplementing cattle to meet MP requirements when fed diets of CCDS and hay did not improve ADG at levels greater than 15% CCDS.

Effects of Feeding Condensed Distillers Solubles With and Without Oil Extraction on Growing Cattle Performance. A growing study compared the effects of condensed distillers solubles (CDS) with and without corn oil removal at 20 and 40% inclusion in a grass hay diet and 40% inclusion in wheat straw or grass diets. Fat content had no effect on ending BW, DMI, or ADG but impacted F:G. Steers fed normal fat CDS had 13.6% greater F:G at 20% inclusion but only 1% greater F:G at 40% inclusion than de-oiled CDS. In normal CDS at 40% inclusion, oil content hindered fiber digestion.

Replacement of Grazed Forage and Animal Performance When Distillers Grains are Fed in a Bunk or on the Ground. An experiment estimated forage savings, performance,

and ground feeding efficiency when supplementing yearling heifers with modified distillers grains with solubles (MDGS) at 0.6% of BW on native Sandhills range. Supplemented heifers had 1.28 lb greater ADG and consumed 15.9% less forage. Each 1 lb of MDGS supplement fed replaced 0.7 lb of forage. Loss of MDGS when ground-fed was 4.3%. Supplementing spayed yearling heifers with MDGS at 0.6% BW decreased forage consumption 15.9% and increased gain.

Field Peas as a Binder for Dried Distillers Grains-Based Range Cubes. Cattle supplemented dried distillers grains in the bunk or a 25% field pea/75% distillers grains cube fed on the ground gained similarly and outgained cattle supplemented dried distillers on the ground. A 25.6% loss of the distillers grains fed loose on the ground was estimated. The similar performance of cattle fed distillers grains in the bunk and those fed pea/distillers cube on the ground suggests field peas reduced distillers grains loss.

Strategic Supplementation of Dried Distillers Grains Plus Solubles to Yearling Steers Grazing Smooth Bromegrass. Steers supplemented daily with dried distillers grains plus solubles (DDGS) on nonfertilized smooth bromegrass pastures had ADG 0.59 lb/day greater than unsupplemented steers. Steers strategically supplemented with DDGS gained 2.47 lb/day while steers supplemented daily at 0.6% of BW gained 2.68 lb/day, both greater than unsupplemented steers at 1.99 lb/day. Strategic supplementation with increasing levels of DDGS as forage digestibility declined did not improve cattle performance over steers supplemented at 0.6% of BW with DDGS daily.

Economic Analysis Update: Supplementing Distillers Grains to Grazing Yearling Steers. Cattle receiving supplement had greater net returns, lower cost of gain, and lower breakeven prices. Fertilizer prices have increased at a greater rate than land costs making it more economical to use a lower stocking rate instead of fertilizing pastures. As land prices increase, the incentive to use either N fertilizer or DDGS supplementation increases.

Effect of Stocking Rate on Cow Performance and Grain Yields When Grazing Corn Residue. Cattle grazing corn residue at a low stocking rate maintained body condition score (BCS) and gained more weight than cattle stocked at a heavy level. Corn plant part digestibilities ranged from 69% to 31% and amount of leaf, leaf sheath, and husk was about 15 pounds per bushel of grain. Subsequent grain yields show no difference between grazed, baled, or ungrazed treatments.

Forage Resource Management

Effect of Grazing Corn Residue on Corn and Soybean Yields. Grazing corn residue in the fall/winter or spring in either a corn-soybean rotation or a continuous corn system shows generally positive effects on yields. Soybean yields for both fall/winter and spring-grazed corn residue when compared to ungrazed corn residue in a corn followed by soybean rotation show an increase in yields.

Corn Residue Removal Effects On Subsequent Yield. Removing 50% of the residue from rainfed sites reduced corn yield by 1.9 bu/ac, whereas removing 40% of the residue from irrigated sites increased corn yield by 15.4 bu/ac. However, removing 53% of the residue increased soil erosion by 30%. Residue removal should be based on site-specific characteristics and management.

Effects of Corn Hybrid, Plant Density, and Harvest Time on Yield and Quality of Corn Plants. Although whole corn plant DM yield decreased with delayed harvest timing, whole corn plant TDN increased linearly due to increasing grain concentration. Increasing plant density improved yields of grain and whole corn plant DM.

Nitrogen Fertilization and DDGS Supplementation Reduces Annual Weeds in Pastures. Ongoing research has found BW gains of steers supplemented with corn dried distillers grains plus solubles (DDGS) on unfertilized smooth bromegrass pasture (SUPP) to be greater than unsupplemented steers on N fertilized (FERT) and unfertilized, control (CONT) smooth bromegrass pasture. In the seventh year of the study, annual weeds increased to 20%, 9%, and 2% of relative cover within CONT, SUPP, and FERT pastures. Supplementation of DDGS on unfertilized pastures improves steer BW gains and reduces N inputs and reduces annual weed invasion.

Evaluation of a New Chemistry for Rangeland Grasshopper Control. Grasshoppers were numerically reduced the most by Coragen and Prevathon. The highest level of Prevathon did not impact beneficial insects in general. Biomass and forage quality were not significantly impacted by chemical treatment. Prevathon appears to be an acceptable systemic pesticide for grasshopper control with minimal impact on other insects.

Influence of Pre-Collection Diet and Preparation Technique on Nutrient Composition of Masticate Samples. Squeezing masticate samples to remove excess saliva skews forage nutrient composition of high quality, vegetative grass. Lower quality grass or harvested hay is less affected. Mastication increases ash content. Pre-collection diet of fistulated animals has no effect on nutrient content of the masticate.

Finishing

Replacing Steam-Flaked Corn and Dry Rolled Corn With Condensed Distillers Solubles In Finishing Diets. As condensed distillers solubles (CDS) replaced corn at either 15 or 30% of the diet DM, DMI intake decreased quadratically for both steam-flaked corn (SFC) and dry rolled corn (DRC). Within DRC based diets, ADG increased quadratically with 15% CDS being greatest and F:G improved quadratically with 30% inclusion being best. When SFC was used as the grain source, ADG increased linearly and F:G improved quadratically with increasing levels of CDS.

Association of Inactive Myostatin in Piedmontese-Influenced Steers and Heifers on Performance and Carcass Traits at Different Endpoints. Performance and carcass traits were evaluated using Piedmontese-influenced steers and heifers and genotyped for zero, one, or two copies (homozygous active, heterozygous, or homozygous inactive) of the inactive myostatin allele. Steers and heifers had similar responses across genotypes in performance and carcass traits evaluated at different endpoints. Inactive myostatin decreased DMI, final BW (live), and ADG (live). Increased dressing percentage resulted in increased carcass-adjusted ADG and improved feed conversion for cattle with inactive myostatin. Cattle with inactive myostatin are leaner with larger LM area.

Varying Proportions and Amounts of Distillers Grains and Alkaline-Treated Forage as Substitutes for Corn Grain in Finishing Cattle Diets. Dietary treatments were two ratios (2:1 or 3:1) of modified distillers grains and treated crop residues (DGCR) with 5% CaO, two types of treated crop residue (corn stover or wheat straw) at 3:1 ratio, and then with three dry rolled corn (DRC) levels (10%, 25%, 40%; DM basis). Steers fed diets containing as little as 25% corn and 3:1 ratios of distillers grains and CaO treated crop residues can achieve similar F:G compared with cattle fed diets containing 5% roughage and 56% corn.

Evaluation of Rumen Metabolism and Digestibility when Treated Crop Residues are Fed in Cattle Finishing Diets. Treated (25% CaO treated forage) diets had greater digestibility of DM, OM, and NDF compared to untreated diets. Substituting 15 percentage units of corn and 10% roughage with 25 percentage units of 5% CaO treated cobs, wheat straw, or corn stover resulted in similar DM digestibility, rumen pH and VFA concentrations.

Effects of Feeding 44 g/ton Rumensin® During Grain Adaptation on Animal Performance and Carcass Characteristics. Cattle were adapted to a finishing diet over 20 days while feeding 33 or 44 g/ton (DM) of Rumensin. Following grain adaptation, all cattle were fed a common finishing diet containing 33 g/ton Rumensin for the remainder of the feeding period. Feeding 44 g/ton of Rumensin during the adaptation period did not affect performance during the adaptation period or over the entire feeding period.

Comparing Wet and Dry Distillers Grains Plus Solubles for Yearling Finishing Cattle. Long yearling steers were used to compare wet distillers grains plus solubles (WDGS) and dried distillers grains plus solubles (DDGS) to a corn control (CON) when included at 35% of diet DM in finishing diets. Final BW was heavier for WDGS and DDGS as a result of increased ADG. Cattle fed WDGS were most efficient, DDGS intermediate, and CON the least efficient. The feeding values were 31.3 and 21.5% greater for WDGS and DDGS than corn.

Effects of Modified Distillers Grains Plus Solubles and Condensed Distillers Solubles With and Without Oil Extraction on Finishing Performance. A finishing study was conducted to evaluate the effects of feeding 27% inclusion of condensed distillers solubles (CDS) and 40% inclusion of modified distillers grains plus solubles (MDGS) with and without corn oil removal. De-oiled CDS or MDGS did not impact performance or carcass characteristics. Cattle fed CDS or MDGS, regardless of fat content, had greater final BW, ADG, and HCW compared to controls. Feed conversion, regardless of fat content, was greatly improved for CDS or MDGS compared to controls.

Effects of Feeding Microbial Feed Additives on Growth Performance and Carcass Traits of Steers Fed Steam-Flaked Corn-Based Diets with Wet Distillers Grains Plus Solubles. Dietary treatments included a control diet without direct-fed microbials (DFM), and two commercially available products (10-G and Bovamine). No significant differences were observed among treatments for animal performance or carcass characteristics.

The Effect of Lameness on Average Daily Gain in Feedlot Steers. The ADG for data set 1 steers with lameness late in the feeding period (≥ 60 days) was 0.04 lb/day less than steers without lameness. The ADG for data set 2 steers with lameness later in the experimental trial period was 0.2 lb/day less than steers without lameness.

Effect of Feeding Greater Amounts of Calcium Oxide Treated Corn Stover and Micro-Aid® on Performance and Nutrient Mass Balance. Feedlot performance and mass balance were evaluated on steers fed either 5% untreated corn stover (CON), 20% untreated corn stover (NONTRT), or 20% calcium oxide (CaO) treated corn stover (TRT) when fed with or without saponins (Micro-Aid). In both WINTER and SUMMER experiments, ADG, F:G and HCW were improved in CON and TRT fed steers compared to NONTRT fed steers. Micro-Aid fed steers had slightly greater ADG and DMI in the SUMMER. Manure, % nitrogen (N) was greatest when NONTRT and TRT were fed compared to steers on CON diet. However, neither diet nor Micro-Aid influenced manure N amounts or N losses across both seasons.

Feeding Elevated Levels of Corn Silage in Finishing Diets Containing MDGS. Steers were fed 15, 30, 45, or 55% corn silage in diets with 40% MDGS. Two additional treatments were tested with 30% corn silage and 65% MDGS and 45% corn silage and 0% MDGS. As corn silage inclusion increased, there was a slight linear increase in F:G with a linear decrease in DMI and ADG. However, ADG and F:G were improved when corn silage was fed with MDGS.

Economics of Feeding Elevated Levels of Corn Silage in Finishing Diets Containing MDGS. Economic assumptions were applied for substitution of corn with corn silage in diets with modified distillers grains plus solubles (MDGS) for determination of cost of gain and profit per head when corn was priced at $3.50, $5.00, or $6.50 per bushel and corn silage was priced at 8, 8.5, or 9 times the bushel price of corn on an as-is basis. Cost of gain linearly decreased and profit per head linearly increased as corn silage inclusion increased when corn silage was priced at 8 and 8.5 times the price of corn.

Rapidly Transitioning Cattle to a Finishing Diet with RAMP®. Cattle were transitioned from RAMP to a finishing diet over 27 or 28 days by decreasing RAMP (100 to 0%) and increasing finisher (0 to 100%) gradually over 4 steps or rapidly in fewer days and with fewer steps. Following adaptation, cattle were fed a common diet until slaughter. Grain adaptation treatment did not affect performance or carcass characteristics. Cattle can transition from RAMP to a finishing ration containing 47.5% Sweet Bran® in fewer days.

Transitioning Cattle from RAMP® to a Finishing Diet With or Without an Adaptation Period. Cattle were transitioned from RAMP to a finishing diet gradually over 28 days by decreasing RAMP (100 to 0%) and increasing finisher (0 to 100%) gradually over 4 steps, rapidly in 2 steps or abruptly without an adaptation step. Transitioning cattle from RAMP to a finishing diet in 2 steps or without an intermediate step did not affect performance or carcass characteristics compared to a more traditional 4-step program. Cattle transitioned directly from RAMP to a finishing ration had greater among day intake variation and lower DMI after the abrupt transition but had less DMI variation following a transition to final finishing diet. Cattle fed RAMP for 10 days can be transitioned to a finishing ration containing 47.5% Sweet Bran® abruptly.

Effects of Abruptly Transitioning Cattle from RAMP® to a Finishing Diet on Ruminal pH and Feed Intake. Adaptation programs included either a 4-step system that decreased RAMP (100 to 0%) while increasing inclusion of the finishing ration (0 to 100%) gradually over 4 steps or a 1-step system where cattle were fed RAMP for 10 days and switched directly to a 47.5% Sweet Bran® finishing ration on day 11. Abruptly transitioning cattle in 1 step to a finishing ration containing 47.5% Sweet Bran decreased average pH while increasing time below pH 5.3 and pH variation compared to the 4-STEP system. Eating time increased as a result of 1-step when cattle were on the final finishing ration.

Using RAMP® for Receiving Cattle Compared to Traditional Receiving Diets. Treatment diets were fed for an average of 31 days in year1 and 24 days in year 2. Diets included a control receiving diet consisting of alfalfa hay, Sweet Bran®, dry rolled corn, and supplement or RAMP which is a complete starter ration containing a high level of Sweet Bran and a minimal amount of forage. Across both years, RAMP improved F:G but was due to increased ADG in year 1 and decreased DMI in year 2. Feeding RAMP to newly arrived calves improved feed efficiency.

Utilization of Soybean Hulls When Fed in Combination with MDGS in Finishing Diets. Soyhull inclusion level was 0, 12.5, 25, or 37.5% of diet DM. As soyhulls replaced dry rolled corn (DRC), ADG decreased linearly and F:G increased linearly in response to increasing levels of soyhulls. When comparing the feeding value of soyhulls relative to corn, feeding values decreased from 70 to 60% of corn as dietary inclusion of soyhulls increased from 12.5 to 37.5% of DM.

Effects of Feeding Increasing Levels of Soyhulls in Finishing Diets with WDGS. The effects of including 0, 12.5, 25, or 37.5% soyhulls fed in combination with 40% wet distillers grains solubles (WDGS) were evaluated. Gain was greatest at the 12.5% inclusion level, but similar ADG was observed between 0 and 25% inclusion levels. Feed conversion (F:G) decreased by 2.4% and HCW increased 13 lb when including 12.5% soyhulls in the diet compared to steers fed 0% soyhulls. Results from this study suggest that 12.5% soyhulls can replace a portion of corn in finishing diets that contain WDGS in calf-feds diets.

Including NEXT ENHANCE® Essential Oils in Finishing Diets on Performance With or Without Rumensin® and Tylan®. Treatments consisted of 1) control (CON), 2) NEXT ENHANCE at 300 mg/day (NE), 3) Rumensin and Tylan at 360 and 90 mg/day, respectively (RT), or 4) NEXT ENHANCE plus Rumensin and Tylan (NERT). No NEXT ENHANCE by Rumensin/Tylan interaction was observed. Steers fed Rumensin/Tylan had decreased F:G and increased live final BW and marbling score. The prevalence of liver abscesses decreased 46% when steers were fed Rumensin/Tylan. Including NEXT ENHANCE in finishing diets did not impact performance or carcass characteristics.

The Effect of Commensal Microbial Communities on the Fecal Shedding of Shiga Toxin-Producing *E. coli* (STEC) in Beef Cattle. Shedders were identified among 170 beef animals over three time periods using selective microbiological culture media. The isolated bacterial cultures were confirmed to be STEC using PCR, 16s rRNA sequencing and a shiga toxin immunoassay. The most abundant strains found in the cattle feces were those belonging to the serogroups O111 (40.3%) and O157:H7 (37.3%), with O103 (8.3%), O26 (6.0%), O83 (4.5%), and O55 (3.0%) being detected in much lower numbers . Out of the 52 animals which were identified as super-shedders of STECs which were selected for microbial community analysis, 61.54% shed STEC in at least two of the three sampling time points.

Hormonal Residues in Feedlot Pens and Runoff. Within a trial, heifers were assigned randomly to 2 groups: 1) treatment (TRT) animals were administered synthetic hormones via subcutaneous implants (Ralgro and Revalor-H) and fed Melengesterol Acetate (MGA), or 2) control (CON) animals with no synthetic hormone provided. Gains and feed conversions were 18.8 and 7.5% better, respectively, for TRT, while CON had 16.7% greater choice and prime carcasses. In runoff samples, progesterone was greater for CON. With the exception of androsterone, average hormonal concentrations in pen surface samples were less than 11 ng/g and concentrations of all compounds were not different across treatments.

Anaerobic Digestion of Finishing Cattle Manure. Utilizing manure from cattle fed distillers grains in anaerobic digesters improved methane production and DM degradation of manure compared to manure from cattle fed no distillers grains. Manure from cattle fed in open lot pens had soil contamination which decreased OM content and led to decreased total methane production. If ash buildup is avoided, open lot manure can be used as anaerobic digester feedstock.

Beef Products

Development of 2-Rib and 3-Rib Beef Chuck Subprimal. Forequarter breaks at the third/fourth and fourth/fifth rib junctions were evaluated in six beef carcasses each. Chuck roll subprimals from both fabrication methods were prepared. All muscles were weighed and a shear force assessment was conducted on steaks from the *Longissimus dorsi*. There were no differences in tenderness between 3, 4, or 5 rib *Longissimus dorsi* steaks.

Differences in Beef Strip Loin Steaks of Steers Due to the Inactive Myostatin Mutation. Strip loins from steers with genotypes containing zero, one, or two copies of the inactive myostatin mutation (IM) were obtained. Loins were cut into 1-inch steaks where total number of steaks and total numbers of steaks with gluteus medius were noted. Loins from zero copy cattle had a higher total number of steaks, but no difference in proportion of steaks, both with and without the gluteus medius compared to one and two copy cattle.

Variation in Composition and Sensory Properties for Beef Short Ribs. Beef short ribs were collected from both sides of 10 Choice beef carcasses. Short ribs from the left side were utilized in a yield assessment and the right sides were prepared for a trained sensory panel. Ribs 9-12 had the greatest percent fat per rib and lower percent lean. Ribs 5-7 were intermediate in percent lean. Rib 5 was similar to ribs 9-10 for tenderness, and ribs 11-12 were rated least tender. Ribs 6-8 were rated highest for juiciness and ribs 5 and 11 were rated least juicy.

An Evaluation of the Extended Sirloin Cap Coulotte. Extended sirloin caps were removed with a knife prior to round/sirloin fabrication. Steaks from the cap were cut parallel or perpendicular to muscle fiber direction. Steaks, regardless of cutting style, were more tender, juicier, and had less connective tissue towards the anterior of the cap. Lower shear force values also occurred at the anterior tip. Steaks cut parallel to muscle fiber direction had lower shear force values compared to perpendicular cut steaks.

An Evaluation of Pelvic Bone Shape in Beef Carcasses. Pelvic bones from the right side of twenty five beef carcasses were collected and analyzed to characterize the variation in bone shape. Weight of the hip bone, aitch bone, and total pelvic bone increased with increasing carcass weight. Aitch bone and pelvic lengths were longer for steers than heifers. Location of the cut separating beef sides had a major impact on shape of the exposed aitch bone.

Color and Sensory Properties of Beef Steaks Treated with Antimicrobial Sprays. Beef steaks were treated with different antimicrobial sprays (560 ppm bromine, commercial blend containing 2.48% lactic acid, acetic acid, and potassium hydroxide, 4.17% lactic acid, and an unsprayed control) to determine their antimicrobial effectiveness and effect on color and palatability properties. Consumer sensory panels for Psoas major steaks revealed samples treated with lactic acid were more preferred for juiciness and flavor. Lactic acid and the commercial blend were the most effective antimicrobial treatments against generic E-Coli. Steaks treated with the commercial blend product showed the lowest overall discoloration resulting in the greatest consumer appeal.

Nutrient Differences of Beef from Steers with Different Genotypes for Myostatin. Strip loins and eye of rounds from steers genotyped as having zero, one, or two copies of the inactive myostatin (IM) mutation were obtained. Steaks for nutrient analysis were cut and frozen and steaks for tenderness were aged for 14 days and cooked fresh, never frozen. Meat from cattle with one copy and two copies were more tender than zero copy cattle for eye of round steaks. Homozygous IM cattle had less overall fat content and calories than homozygous normal cattle.

This publication has been peer reviewed.

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