

Beef Cattle Research Report – 2004

Department of Animal Sciences
University of Wisconsin-Madison



Jeffrey W. Lehmkuhler
Editor



Introduction

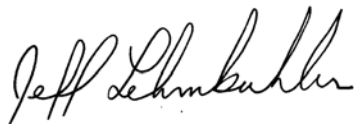
The faculty and staff of the Animal Sciences department are pleased to present this edition of the University of Wisconsin Beef Report. The report summarizes activities occurring within the department over the last year and provides an update of progress made during 2004.

The Animal Science research program is a multi-disciplinary approach that combines the expertise of several departments on campus, county-based extension personnel, and individuals within the industry. Areas of beef research conducted address issues producers are facing now and in the future.

This report attempts to bring together research and activities related to the beef industry conducted through our department and relay it to the industry in an easy to read format. We attempted to keep things brief and in the process not all data maybe represented and you are encouraged to contact the researchers for additional information. Additionally, several projects are in their infancy and data reported here may change slightly as the data are finalized. It is important to the department to give supporters the opportunity to see what the faculty and staff connected to the beef program are currently involved with. We will continue to improve upon this effort and welcome feedback.

We hope you enjoy this overview and the Animal Sciences department looks forward to serving the beef industry in the upcoming year.

Sincerely,

A handwritten signature in cursive script that reads "Jeff Lehmkuhler".

Jeff Lehmkuhler, Ph.D.
Extension Beef Cattle Specialist and Assistant Professor

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Beef and Capacitor Discharge System Processor Factors Affecting Tenderization Efficacy

Dr. James R. Claus (October 4, 2004)

Introduction

Exposing meat to shock waves has been shown to tenderize meat. Hydrodynamic shock waves (HSW) can be generated by the detonation of explosives in water or more recently using an electrical capacitor discharge system (CDS), based on pulsed-power plasma technology. The CDS allows for the opportunity to easily exposed meat to multiple treatments and various shock wave energies beyond what was available with the explosive-based systems. Research supported by Wisconsin Beef Council was undertaken to investigate the effects of beef age at the time of CDS processing and the uniformity of tenderization by this system.

Methods

Objective 1- Determine the effects of postmortem meat age prior to CDS application.

Beef muscles (n=12, anatomically paired strip loins, USDA Select) selected were no more than 2 days old postmortem (36 hr PM). Each anatomical pair of strip loins was cut evenly into four roasts (e.g. each strip loin cut in half). The four roasts were assigned to one of four time periods (0, 3, 6, 9 days) prior to CDS application. Day 0 corresponded to the earliest time the muscles could be obtained and the testing initiated (36 hr PM). On the corresponding aging time, a control steak was removed from the roast prior to CDS application (one pulse). After CDS processing a steak was removed from each roast. Control steaks and steaks from CDS processed roasts were cooked, cored (1/2" diameter), and sheared (WBS, Warner-Bratzler shear) on the same day CDS processing occurred.

Objective 2- Determine the location effects on tenderization in a completely contained processing tunnel

Strip loins (USDA Select, n=10) were used. Control steaks were removed from the rib end (n=1) and frontal to the gluteus medius (sirloin end, SE, n=1). The SE cut was made 9 1/4" from the rib end side before the rib end control was removed. All roasts were pulsed once. An average meat weight per load was 21.9 lb. Immediately after CDS processing six strip loin steaks were removed starting from the rib end (position 1). WBS was determined on room temperature cores (1/2" diameter cores removed parallel to the fibers) from cooked (160 F) steaks.

Results and Discussion

Delaying CDS application until day 3 after procurement (~4-5 d postmortem) dramatically improved the shear force reduction (Table 1). It may be that some level of natural proteolytic aging facilitates making the myofibrillar proteins more susceptible to shock wave tenderization. Overall the shear force decreased by 1.46 lb which would be a significant enough change for a sensory tenderness improvement to be recognized.

The CDS process decreased the mean WBS in both the rib end and sirloin end (Figure 1). The degree of tenderness improvement was higher in the sirloin end most likely because the sirloin end controls were less tender than the rib end controls. Only one strip loin (sirloin end) did not respond favorably to TCS. However, this strip loin was very tender to start. The CDS produced uniformly tender steaks from the rib end steak positioned against the indexer through

the strip loin steak located toward the sirloin end and more centrally located in the processing tunnel.

Conclusions

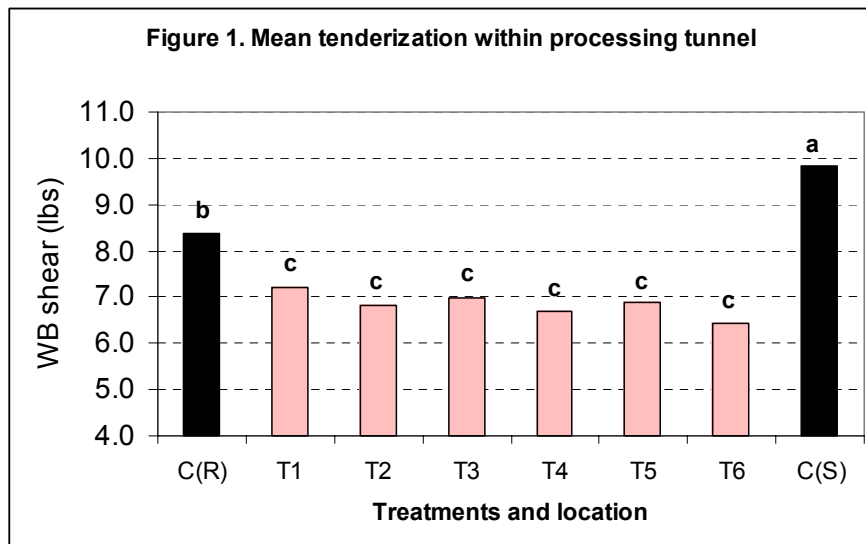
Efficacy of tenderization appears to be dependent upon the time postmortem of treatment. This process has the potential to provide beef consumers with a more uniformly tender product.

Table 1. Day of HSW application on USDA Select beef strip loin tenderness.

Day processed ¹	Warner-Bratzler Shear peak force (lb)		
	Control	TCS	Change (%)
0	12.95 ^a	12.66 ^a	2.2
3	11.54 ^a	9.13 ^b	20.9
6	9.06 ^a	7.07 ^b	22.0
9	8.49 ^a	7.34 ^b	13.5
Overall	10.52 ^a	9.06 ^b	13.9

¹Days PM- 0 was approximately 36 hr PM, N= 12 strip loins (Day 3 only steaks from 11 strip loins). A control steak (day 0) and three roast sections per strip loin (randomly assigned to days PM when processed)

^{ab}Means- There was not a significant (P>0.05) treatment (control vs TCS) by day effect. Means within a row with unlike superscript letters are different (P<0.05). S.E. 0.344



^{abc}Bars with unlike letters are significantly different (P<0.05). Treatments: C(R), control rib side of strip loin; T1-T6, frontal to caudal steaks, shock wave processed; C(S), control steak from the sirloin side of strip loin.

Supplemental Phosphorus Removal for Finishing Holstein Steers: Final Results

A. M. Brokman, J. W. Lehmkuhler, and D. J. Undersander

Introduction

Nutrient management, with an emphasis on phosphorus, has become more important to cattle producers as stricter environmental measures are introduced. Previous research suggests that the phosphorus requirement of finishing yearling steers is less than 0.14% of diet DM (Erickson et al., 1999). Erickson et al. (2002) supported the phosphorus requirement of finishing feedlot calves reporting it to be less than 0.16% of diet DM. These data suggest current NRC requirements overestimate the amount of phosphorus needed in finishing steer diets. Because of limited data regarding phosphorus requirements of Holstein steers, two experiments were performed to determine responses to the removal of supplemental phosphorus from the finishing ration for yearling Holstein steers.

Materials and Methods

In Experiment 1, 96 Holstein steers were blocked into four weight groups and assigned to eight pens. Steers were fed a diet consisting of approximately 74% corn, 18% corn silage and 8% supplement on a DM basis. Dietary treatments, supplemental phosphorus (DC) or no supplemental phosphorus (NDC), were randomly assigned to pens within each block. The phosphorus (dicalcium phosphate) was pre-incorporated into the protein/mineral pellet at a level to achieve 0.3% phosphorus in the complete ration. Steers were implanted with an estrogenic product on d 0. Steers in heavier weight blocks were harvested after 82 d on trial to avoid heavy carcass weight discounts. The remaining steers were harvested on d 125. Carcass data were collected following a 24-hr chill. Experiment 2 consisted of 78 Holstein steers blocked into two weight groups and assigned to eight pens. Steers were fed a TMR consisting of 81% corn, 8% supplement, 6% corn silage, and 5% alfalfa haylage on a DM basis. Steers were implanted as in Experiment 1. Steers were harvested on d 84 and 112 d on test. Carcass data were collected after a 48-hr chill. Steers were implanted on d 0 with an estrogenic implant (Synovex S) in both years. Steers were weighed on two consecutive days at the initiation and termination of the feeding periods with intermittent single day weights obtained at 28 d intervals. The average weight was utilized to calculate average daily gain over the course of the experiment. Feed samples were collected over the feeding periods, dried, ground, and laboratory analysis for DM, ash, nitrogen, calcium, and phosphorus were performed. Rib bone sections were obtained from the ventral portion of the sixth rib for steers harvested in the second group during Experiment 2 for analysis of bone ash, Ca, P, and bending moment.

Results

During period three steers receiving NDC resulted in heavier weights ($P < 0.05$) and a trend for improved gain efficiency ($P = 0.09$) in Experiment 1. The overall gain efficiency for NDC was better than DC ($P < 0.05$). NDC carcasses tended to have a higher trim weight ($P = 0.09$) and a lower percent trimmed than DC carcasses ($P = 0.05$). No differences ($P > 0.05$) were detected for other carcass traits measured. For Experiment 2, NDC tended to be heavier at the end of the trial ($P = 0.07$). No differences ($P > 0.05$) were detected in overall ADG, live weights, overall DM intake or gain efficiency. A trend existed for DC to have higher DMI ($P = 0.10$) during period three in comparison to NDC. The lack of response is expected to be

related to the level of dietary phosphorus in the DC ration (0.26% P) as it was in excess of the 1996 NRC recommended requirement of 0.19%. These trials would suggest that additional dietary phosphorus is not required for corn-based finishing rations for yearling Holstein steers.

Table 1. Carcass and performance characteristics of Holstein steers supplemented with (+) or without (-) dicalcium phosphate

Item	2002		2003	
	-	+	-	+
P intake lb/d	0.06	0.07	0.06	0.07
Initial Weight (lb)	925	921	1099	1088
Final Weight (lb)	1337	1324	1447	1437
DMI (lb/d)	23.26	23.66	24.38	24.45
Gain: Feed*	0.15*	0.14*	0.15	0.15
Hot Carcass (lb)	794	786	844	836
Back Fat (in)	0.21	0.19	0.22	0.20
Rib Eye Area (in ²)	11.3	11.3	12.5	12.3
% KPH Fat	1.92	1.96	--	--
Calculated Grade	2.81	2.73	--	--
USDA Grade	2.17	2.10	1.89	1.97
Marbling Score ¹	595	584	584	594
Trim Weight (lb)**	--	--	804**	791**
% Trim *	--	--	4.90	5.41

*Treatment means within the same year differ at the 0.05 probability level

**Treatment means within the same year differ at the 0.1 probability level

¹500=Small⁰ (Sm), 600=Modest⁰ (Mt)

Table 2. Bone characteristics of Holstein steers fed diets with (DC) or without (NDC) supplemental dicalcium phosphate (Exp 2)

Item	NDC	DC	SE	P ¹
Ca (mg/g bone)	395.33	392.04	10.14	NS
P (mg/g bone)	172.19	173.21	4.77	NS
Ash %	62.14	61.99	1.23	NS
Bending Moment (kg cm)	224.41	210.37	48.72	NS

¹NS= P> 0.10

Targeted Supplementation of Grazing Holstein Steers with Dried Distillers Grains in Combination with Monensin

J Lehmkuhler*, A Crooks, D Undersander; University of Wisconsin

Introduction

Previous research conducted at Lancaster Agriculture Research Station suggests that supplementation during the spring “flush” may not be a viable supplementation strategy due to the high quality and availability of the forages at this time of the year. As the grazing season progresses, forage quality and production typically declines which may reduce performance of stocker steers. The ethanol industry within Wisconsin and other areas of the United States is increasing. This is resulting in a larger quantity of quality feedstuffs that can be utilized by the livestock industry as a source of dietary protein and energy. Primary focus for utilization of these ethanol co-products has been with feedlot segment of the beef industry with limited information on responses to grazing livestock. Additionally, only a few studies have investigated the utilization of ethanol co-products with dairy beef steers. Wisconsin’s dairy industry provides a large number of dairy bull calves. The infrastructure for beef operations in Wisconsin exists as three large federally inspected plants harvest finished cattle as well as plentiful feed resources available for these operations in the form of pasture, grain, and co-products. Incorporation of ionophores into supplements of grazing animals has shown significant improvements in animal performance and efficiency. No information currently is available within the literature regarding targeted supplementation of grazing Holstein steers utilizing ethanol-coproducts in combination with an ionophore.

Materials and Methods

Sixty Holstein steers rotationally grazed a mixed cool-season grass/legume forage base to study responses in performance when supplemented with dried distillers grains with or without monensin. Treatments included non-supplemented control (CON), Dried Distillers Grains with solubles (DDG), DDG plus monensin (RDDG), and a mixture of ground corn, soybean meal and monensin (SBM) at similar levels of crude protein and ionophore as RDDG. Steers were randomly assigned to three grazing groups and treatments within each group. Steers receiving supplements were trained to Calan Broadbent gates prior to pasture turnout. Twelve gates were placed within each grazing group to deliver supplements at a rate of 2 kg/hd/d. Supplementation was initiated after 53 d of grazing and continued for 88 d. Steers were implanted with a single Revalor G implant at turnout and administered an anthelmintic twice during the course of the grazing season. Intermittent weights were collected monthly and average daily gain was calculated for each period, overall, pre-supplement, and supplement periods. Forage samples were collected at weekly intervals, composited by month and analyzed for quality. Initial weights were not equal across treatments and performance responses were analyzed with initial weight as a covariant

Results

During the first portion of the pre-supplement period, CON steers tended ($P < 0.1$) to gain more rapidly than all other treatments. During the last two periods (64 d) of the supplementation period, DDG, RDDG and SBM posted greater ADG ($P < 0.05$) than CON. Additionally during the last 64 d, RDDG resulted in greater ADG ($P < 0.05$) in comparison to DDG with SBM being intermediate and similar ($P > 0.05$) to both. Supplementation increased performance of grazing

Holstein steers by approximately 25% to 40% resulting in a supplement conversion of 5.8, 6.8, and 9.0 kg supplement/kg gain over control (RDDG, SBM, and DDG, respectively). Offering dried distillers grains with an ionophore resulted in performance similar to a corn/soybean mixture. An additive response was observed when an ionophore was offered with dried distillers grains.

Acknowledgements

Badger State Ethanol for DDG donation
 Intervet for donation of SafeGuard

Table 1. Average daily gain of grazing Holstein steers offered dried distillers grains with or without monensin or a corn/soybean meal/monensin after the spring flush.

	CON	DDG	RDDG	SBM	SEM	P-value
ADG, kg/d						
PD 1	0.86 ^A	0.30 ^B	0.46 ^B	0.46 ^B	0.096	<0.05
PD 2	0.73	0.74	0.94	0.91	0.095	NS
PD 3	0.79	0.93	1.03	1.06	0.093	NS
PD 4	0.81 ^B	1.11 ^A	1.28 ^A	1.20 ^A	0.082	<0.05
PD 5	0.82 ^B	0.99 ^A	1.07 ^A	1.05 ^A	0.060	<0.05
PRE	0.80 ^A	0.51 ^C	0.68 ^B	0.67 ^B	0.038	<0.05
SUP	0.81 ^C	1.01 ^B	1.12 ^A	1.10 ^A	0.035	<0.05
TRTSUP	0.82 ^C	1.04 ^B	1.16 ^A	1.11 ^{A,B}	0.044	<0.05
OADG	0.80 ^B	0.82 ^B	0.96 ^A	0.94 ^A	0.026	<0.05

PD 1 & PD 2 = Performance during the non-supplemented time frame
 PD 3 = Transition phase in which corn was offered to attract treatment animals to initiate use of Calan bunks and treatment supplement was phased in replacing corn
 PD 4 & 5 = Time periods in which treatment supplements were offered
 PRE = Performance before supplementation was initiated
 SUP = Performance during the time when treatments were offered including the transition period
 TRTSUP = Performance during the time excluding the transition phase in which only the treatment supplements were offered
 OADG = Performance for the entire grazing season

Feeding Brown Mid-rib Sorghum Sudan Grass or Alfalfa Baleage to Mid-Gestation Beef Cows Demonstration Trial

J.W. Lehmkuhler, A. Crooks, T. Wood

Introduction

Wisconsin, like other Midwestern states, has beef operations that include row cropping and permanent pasture. Row cropping systems allow for flexibility in forage resources that may yield increased dry matter per acre. During the summer, the cool season forage species can have reduced productivity and quality. Implementing warm season forages may increase forage productivity. Sorghum sudan grass is a warm season forage that is utilized in many areas as an alternative forage. Little of this forage is found in Wisconsin. Following the winter of 2002, it was anticipated that forage shortages might be observed due to winter-kill of alfalfa. Therefore, sorghum sudan grass was planted at the Lancaster Agriculture Research Station for demonstration purposes.

Materials and Methods

Seventy-two beef cows were divided into two groups of 36 head to investigate responses to feeding baleage made from either brown mid-rib sorghum sudan grass (SS) or alfalfa (ALF). Brown mid-rib sorghum sudan grass hybrid (Drop-O-Honey, Croplan Genetics) was planted on May 29, 2003 at a rate of 35 lb/acre at the Lancaster Agricultural Research Station. Nitrogen was applied at a rate of 45 lb/acre prior to and following the first harvest. First cutting was conducted on July 21, 2003 and yielded approximately 2.0 ton DM/acre while a second cutting was made on August 25, 2003 yielding 1.75 ton DM/acre. Regrowth following the second cutting was grazed beginning in November as part of the corn stalk residue grazing management. Forage analyses following ensiling for the two cuttings are reported in Table 1. Bales were either line or individually wrapped. Several bales (n=32 for ALF & n=23 for SS) from each cutting and forage type were weighed and recorded. First cutting SS was offered during the first portion of the trial and second cutting was offered during the last portion of the trial. Feed refusals from hay rings from 1st cutting SS were weighed by using a skid loader and box spreader for estimating dry matter intake only as ALF and 2nd cutting SS had no refusals. Cows were stratified based upon age, breed, and initial body condition scores. Weights were taken on two consecutive days at the beginning and end of the study. Body condition scores were recorded at the start and termination of the trial by two individuals and the mean utilized. Baleage was offered for 35 days beginning November 14, 2003. Data for all cows and age divisions of 1 year (yearlings), 2 & 3 year old cows (2&3), and greater than 4 years of age were compared for the two forage sources.

Results

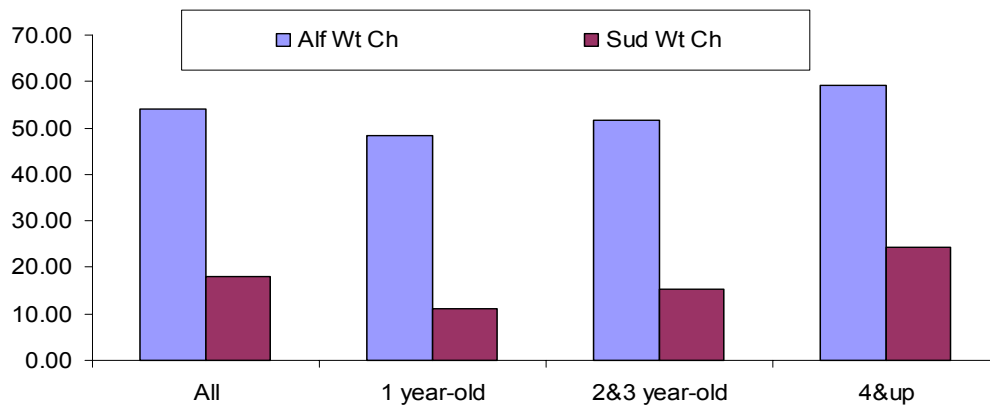
Calculated data indicated that cows consumed on average more alfalfa than sorghum-sudan grass forage (31.5 lb DM/d versus 25.9 lb DM/d). The cows consuming alfalfa had weight gains of nearly 1.0 lb/d greater than sorghum sudan grass (1.46 lb/d and 0.49 lb/d). Younger cows gained less body weight than older cows regardless of treatment illustrating the higher nutrient demands of young cows. BCS changes were more variable due to the small amount of change and subjectivity of this measurement, but followed similar patterns as weight gain for SS. Marginal nitrates levels were found in both cuttings of the sorghum sudan hybrid (1100-1300 ppm). The first cutting levels are believed to be related to excess nitrogen fertilizer application

as manure N credits from cows overwintered on the crop land was not considered when applying N at planting. Levels in the second cutting were attributed to drought conditions experienced in Wisconsin in July and August. No detrimental effects were noted with the marginally high nitrate N levels contained in the sorghum sudan grass baleage. Brown mid-rib sorghum sudan baleage was able to maintain mid-gestation cows at or slightly above maintenance.

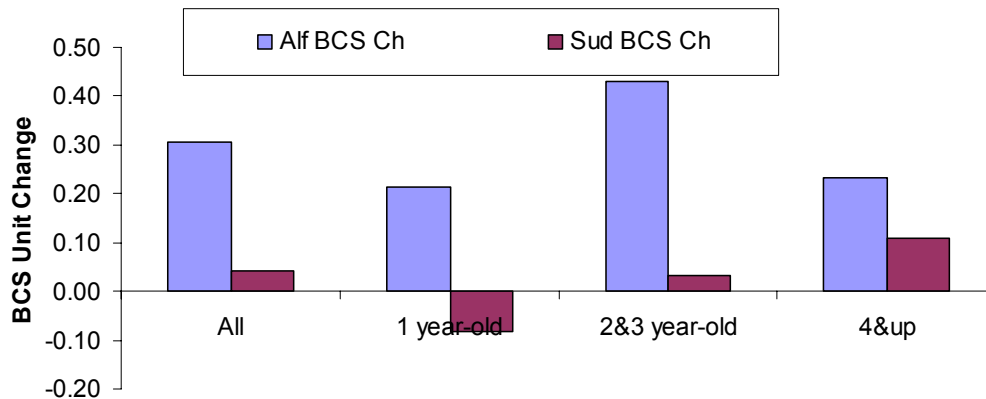
Table 1. Nutrient analysis of brown mid-rib sorghum sudan and alfalfa baleage offered to beef cows during the winter of 2003.

	Sorghum-sudan 1 st / 2 nd cutting	Alfalfa
DM, %	33.8 / 67.3	61.4
CP, %	14.5 / 12.4	20.9
ADF, %	33.2 / 34.1	26.6
TDN, %	60.6 / 64.9	62.4
NO ₃ - N, ppm	1316 / 1108	150

Body Weight Change for Cows Consuming 3rd Cutting Alfalfa or 1st and 2nd Cutting Sorghum-Sudan grass Baleage



Change in Body Condition Score of Cows Offered 3rd Cutting Alfalfa or 1st & 2nd cutting Sorghum-sudan grass baleage



Brief Note: Healthy Components of Beef Fat

Daniel E. Butz¹ and Mark E. Cook²

Conjugated linoleic acids (CLA) are isomers of linoleic acid found in beef and dairy fats. Research interest has grown over the years because of CLA's unique biological effects. CLA was first discovered in the late 1980's as an anti-carcinogenic compound in pan-fried hamburger. The anti-cancer property has been confirmed and other biological properties, such as reduced atherosclerosis and enhanced immunity, have been discovered. More recent research has been directed at anti-inflammatory actions of CLA. Rheumatoid arthritis is a chronic and degenerative disease that causes severe inflammation and degradation of joints, especially joints in the hands and feet. Using animal models our lab has demonstrated that feeding CLA can significantly reduce joint inflammation associated with arthritis. This is the first time that dietary CLA has been shown to reduce arthritis-associated inflammation, and suggests that CLA derived from beef and dairy products may promote healthy joints.

A study presented at the 2004 Federation of America Societies for Experimental Biology

1=Interdepartmental graduate program in nutritional sciences, UW-Madison

2=Animal sciences, UW-Madison

Mapping of bovine ovulation rate QTL; an analytical approach for three generation pedigrees.

J.A. Arias and B.W. Kirkpatrick
Published in Animal Genetics vol. 35, pg. 7-13.

Summary

Interval mapping was conducted for ovulation rate quantitative trait loci (QTL) using data from two related families from the USDA, U.S. Meat Animal Research Center twinning cattle herd. Both families are extended, three generation pedigrees from which records of sons, daughters and granddaughters were analyzed. Both a method of analysis and results from that analysis are reported herein. Results from one of the two families (839802) were previously reported, but reanalysis here including the second, related family (839803) and a revised statistical model lessens support for the previously reported QTL. Results from interval mapping provided evidence for QTL in regions corresponding to those previously suggested for chromosomes 7 (chromosome-wise $P < 0.05$) and 19 (chromosome-wise $P < 0.01$) in the 839802 family, although statistical significance was reduced. In contrast to the previous report, evidence for a chromosome 5 QTL in the same family was greatly reduced while support for a QTL on chromosome 10 increased (chromosome-wise $P < 0.01$). Analysis of data from the related 839803 family failed to replicate evidence of QTL observed in either chromosome 7 or chromosome 19 in the 839802 family.

Identification of an ovulation rate QTL in cattle on BTA14 using selective DNA pooling and interval mapping.

M.G. Gonda, J.A. Arias, G.E. Shook and B.W. Kirkpatrick
Published in Animal Genetics vol. 35, pg. 298-304

Summary

Increased twinning incidence in beef cattle has the potential to improve production efficiency. However, phenotypic selection for twinning rate is difficult because of the trait's low heritability and the long time interval necessary to collect phenotypic records. Therefore this trait and the correlated trait of ovulation rate are ideal candidates for marker-assisted selection. The objective of this study was to complete a genome-wide search for ovulation rate quantitative trait loci (QTL) in two related sire families. The families (paternal halfsib sires 839802 and 839803) were from a population of cattle selected for ovulation rate at the USDA Meat Animal Research Center, Clay Center, Nebraska. Putative ovulation rate quantitative trait loci have previously been identified in the 839802 family on chromosomes 7 and 19; however, marker coverage in the original scan was not complete. This study fills the gaps in marker coverage of the earlier study by adding approximately 60 informative microsatellites to each sire family. Each family was genotyped using selective DNA pooling. Sons and daughters were included in either the high or low pool based on their estimated breeding value deviations from the midparent average (EBVMD) for ovulation rate. Approximately 40% (839802) and 26% (839803) of available progeny comprised the high and low pools combined. Pooled typing revealed possible associations (nominal $P < .05$) between ovulation rate and marker genotype for eleven and fifteen microsatellites in the 839802 and 839803 families, respectively. Subsequent interval mapping strengthened support for the presence of an ovulation rate QTL on BTA 14 (chromosome-wise $P < 0.02$).

Common Abbreviations

ADG	Average Daily Gain
G/F	Unit of gain per unit of feed = Inverse of F/G
F/G	Unit of feed per unit of gain = Inverse of G/F
DMI	Dry Matter Intake
DM	Dry Matter
BW	Body Weight
CP	Crude Protein
TDN	Total Digestible Nutrients
IVDMD	In Vitro Dry Matter Digestibility
NDF	Neutral Detergent Fiber
ADF	Acid Detergent Fiber
IVP	In Vitro Produced
AI	Artificial Insemination
ET	Embryo Transfer
SEM	Standard Error of the Mean
kg	kilogram(s)
lb	pound(s)
d	day
wt	weight
wk	week
DOF	Days On Feed
REA	Rib-eye Area
YG	Yield Grade
QG	Quality Grade
HCWT	Hot Carcass Weight

Conversion

Kg to lb = multiply by 2.21

Lb to kg = multiply by 0.454