*Mississippi State University*

# Animal and Dairy Sciences

## Department Report • 2011

MISSISSIPPI STATE UNIVERSITY
College of Agriculture and Life Sciences

MISSISSIPPI STATE UNIVERSITY
EXTENSION SERVICE

MISSISSIPPI MAFES AGRICULTURAL & FORESTRY EXPERIMENT STATION

Editors: J. A. Parish, T. B. Schmidt, and S. Hill Ward

Division of Agriculture, Forestry and Veterinary Medicine
Mississippi State University
October 2011

October 1, 2011

To Livestock Producers, Industry Leaders, Alumni, Friends of the Department and Others:

The Faculty in the Animal and Dairy Sciences Department present to you this annual report in order to inform you of recent research, teaching, and extension efforts of our department and hope this report will be useful to you. This report is available on the departmental website at *www.ads.msstate.edu*. We encourage you to visit the ADS website often to learn more about the department of Animal and Dairy Sciences at Mississippi State University.

As we reflect on the past accomplishments we look forward to the opportunities and challenges of 2012. Dr. Terry Kiser retired as Department Head after over 14 years of service to the department this past August. Currently, a search for a department head has been conducted, and our Faculty are looking forward to the announcement of the candidate selected who will provide leadership for the department in the coming years. Your input and involvement in the department are welcomed as we work to address the livestock industry concerns either through educational programs or research and training of students who are our future livestock leaders. Although our department is experiencing a change in leadership, our Faculty remain dedicated and working hard to continue serving the citizens of our state through the teaching, research and extension livestock programs. We value your interest and support for our department and welcome you to visit the department anytime.

Our Faculty appreciate the resources available to our department and the spirit of collaboration with other departments and centers at Mississippi State University. Research and extension centers are located strategically throughout the state. Animal research facilities at the Leveck Animal Research Center, Ballew Hall MSU Meats Lab, Bearden Dairy Cattle Research Center, Prairie Research Unit, Brown Loam Research Station, and the White Sands Unit give faculty opportunities to investigate the issues and challenges facing the livestock industry.
Feel free to contact individual faculty members if you have questions or desire additional information.

Sincerely,

Mark Crenshaw, Ph.D.
Interim Head, Extension Professor

# Departmental Scholarships

**A. M. Leed**
Department of Animal and Dairy Sciences, Mississippi State University, Mississippi State, MS

## Teaching Summary

The Department of Animal and Dairy Sciences has always had the rich tradition of presenting scholarships to a large number of deserving students. Scholarships awarded for the 2011-2012 academic year were no exception due to generous alumni and former faculty members. Incoming and current students submitted a record number of applications which were reviewed and scholarships were awarded at the Animal and Dairy Sciences' Awards Banquet.

## Introduction

Scholarship applicants answered a variety of questions about interests, activities, goals, and past academic performance. The various scholarships the department offered have a range of specifications, requiring the committee to match each scholarship with the most deserving student. The majority of scholarships were awarded to current undergraduate students, but several were presented to incoming students.

## Procedures

Both incoming students and current students were eligible to apply for departmental scholarships. Application forms, located on the departmental website, were completed by students and submitted either electronically or by hard copy to the scholarship chairperson. Scholarship applications must be received by February 1. After that date the scholarship committee, composed of departmental faculty, reviewed and evaluated the applications.

## Results

The department awarded $20,000 in scholarship money to Animal and Dairy Science students. Twenty-one undergraduate scholarships were awarded. The following list is the scholarships awarded and recipients:

- *Bryan and Nona Baker Endowed Scholarship* – Matt Woolfolk and Lacy Priest
- R*ev. and Mrs. William Page Brown Memorial Scholarship* – Jordan Craig
- *Miles Carpenter -Bill McGee-Higgins Endowed Scholarship* – Diana Kaitlyn Hardin
- *Billy Gene Dig Memorial Scholarship* – Lanna Durst
- *Fuquay Endowed Scholarship* – Brandon Yelverton
- *Henry H. Leveck Memorial Scholarship* – Ashleigh Thomas, Ryan Kennedy, and Kathleen Barton
- *Janice McCool Durff and Alma McCool Liles Scholarship* – Cori Webb, Emerald Barrett, Dorothy Reagan Bugg, Andrea Seitz, and Joanna King
- *Glenn McCullough Scholarship* – Rachel Howell
- *Rodney Moore Scholarship* – Morgan Fuller

- *Enoch Norton Endowed Scholarship* – Taylor King and Rachel Montgomery
- *W.L. Buddy Richmond Scholarship* – Caitlin Quinn
- *O.W. Scott Scholarship* – Thomas Ryan Andrews
- *Linda "Big Lou" Schuerer Scholarship* – Chelsea Meyer

## Implications

Scholarships provide deserving students the funds necessary to pay tuition, purchase books, and help defray living expenses. As the cost of education continues to rise, scholarships play a critical role in paying for higher education. Also, scholarships offer a way to compensate students for their hard work in the classroom and their involvement on campus. In June 2011 the Mississippi Equine Association developed a new departmental scholarship which will be awarded for the first time this upcoming academic year.

# A Decade of Equestrian Competition

**M. C. Nicodemus**
Department of Animal and Dairy Sciences, Mississippi State University, Mississippi State, MS

## Teaching Summary

The 2011 spring semester marked a decade of equestrian competition by students at Mississippi State University. During the 2010-2011 show season Mississippi State University was represented at five Intercollegiate Horse Show Association competitions starting in October 2010 and completing the regular season in March 2011. Mississippi State University 2010-2011 hunt seat team consisted of eleven undergraduate riders and two alumni riders and the stock seat team consisted of six undergraduate riders. Team members prepared for competitions through riding lessons scheduled before each competition and met regularly throughout the semester during Mississippi State University Horseman's Association meetings where team members signed up for competitions and organized the competition trips. Through a decade of competitions, Mississippi State University remains the longest running collegiate equestrian team in Mississippi and is the only Mississippi collegiate equestrian team that has competed at any stock seat competition.

## Introduction

Mississippi State University in the fall of 2000 began organizing the first collegiate equestrian team in Mississippi with the Mississippi State University team attending their first competition in the spring of 2011 at Middle Tennessee State University with a total of fourteen hunt seat riders. This spring is the 11th year of competition; making the Mississippi State University's equestrian team the longest running collegiate team in Mississippi. During the past 11 years of competition, Mississippi State University has remained the only Mississippi collegiate team to compete in stock seat competitions and is the only Mississippi collegiate team to compete in a National Collegiate Athletic Association sanctioned varsity invitational horse show. For a decade, the Mississippi State University team has competed in Region 1 of Zone 5 of the Intercollegiate Horse Show Association. Throughout its history, the Mississippi State University equestrian team has remained a club sport associated with the Animal and Dairy Sciences department that is open to all full-time undergraduate students at Mississippi State University. Last year the team was open up to alumni riders with two former Mississippi State University hunt seat riders coming back to represent Mississippi State University in the Intercollegiate Horse Show Association alumni division. This year Mississippi State University was the only Mississippi school represented in the alumni division.

## Procedures

*Membership Requirements*

While tryouts have never been a requirement of becoming a member of the Mississippi State University equestrian team, potential new members need to be full-time undergraduates at Mississippi State University and are required to fill out a riding proficiency questionnaire developed by the coaching staff of the Mississippi State University equestrian team to determine

their level of riding. All levels of riders from beginner to open can compete at an Intercollegiate Horse Show Association competition and the questionnaire assists in determining the level of riding that best fits those new riders competing on the team. New members are also required to set up a riding lesson with local trainers working with the equestrian team where the trainers will evaluate the new riders to provide additional input to the riding questionnaire. For the past two years, Mississippi State University equestrian team has opened up its membership to alumni riders. While the alumni riders for the past two years had been undergraduate members of Mississippi State University equestrian team, alumni membership is open to any graduate of any college that has participated as an undergraduate in Intercollegiate Horse Show Association competitions.

Team membership not only requires a student to be a full-time undergraduate at Mississippi State University and fill out the riding questionnaire team members must also be active members of the Mississippi State University Horseman's Association, which is an equine club that meets every other Tuesday at 6 pm at the Wise Center on the Mississippi State University Starkville campus. Membership includes volunteering at the Dixie Nationals Quarter Horse Show in February at the Mississippi Fairgrounds in Jackson, Mississippi and at the Animal and Dairy Sciences Bulldog Classic Quarter Horse Show in March at the Mississippi Horse Park in Starkville, Mississippi; participating in the Animal and Dairy Sciences Welcome Back Picnic and Ag Olympics; and organizing fundraisers including a bake sale, "Wrangler Butt" photo competition, and horse basket and cow bell raffles. During the Horseman's Association meetings, team members are informed of upcoming competitions and learn more about the requirements for competition. At the second Horseman's Association meeting, team members where given a team handbook that included information about the shows, riding practices, and team forms, and during that meeting, team coaches and captains hosted a question and answer session.

*Competition Preparation*

Intercollegiate Horse Show Association competitions do not require collegiate teams to bring their own horses to competitions. Unlike regular horse shows where competitors must have their own horse and tack, Intercollegiate Horse Show Association competitions are held at host colleges that provide the horses and tack for the competitors so riders are only required to provide their own show clothes. While this type of competition reduces the costs associated with showing, team members must train to ride all types of horses. For the second year, Mississippi State University equestrian team members were required to sign up for weekly practices before each competition using designated practice outlets that were outlined in the team handbook given to team members at the start of the competition season. Team members could select from taking University riding courses or work with designated local trainers as they prepared for competitions. University riding courses included ADS 1132 Intro to Horsemanship, ADS 3233 Equine Assisted Therapy, ADS 2312 Advanced Horsemanship, and ADS 4990 Advanced Horsemanship III. ADS Advanced Horsemanship III was a new special topics course offered this spring where students had an opportunity to ride horses with more advance training working on more advanced maneuvers including jumping courses and pattern work. Students also assisted with the instruction of the lower level riding courses. Along with

selecting from University riding courses, team members could select from local trainers designated by the equestrian team coaching staff that would work with the University at a reduced training rate. The coaching staff, Dr. Molly Nicodemus and John Williams, and team captains, Ally Long and Samantha King, would work with these local trainers to determine the improvements made by team members as the members worked under the direction of the local trainer and to determine whether a team member was ready for competition.

In addition to regularly scheduled riding lessons, this year team members were also encouraged to work out on a regular basis during the show season including team members doing physical activities after each meeting such as running the stairs of the Wise Center. Team members worked out with team captains at the Joe Frank Sanderson Center, Mississippi State University recreational facility, and worked with Sanderson Center athletic trainers in designing a physical fitness program. Team captain Kristen Van Veldhuizen, kinesiology major, tracked team member's weekly exercise activities and coordinated team workouts with the Sanderson Center.

## Results

The spring of 2011 marked a decade of competitions for the Mississippi State University equestrian team with the hunt seat team traveling to four shows and the stock seat team traveling to one during the 2010-2011 show season. In the first two shows of the season, the hunt seat team brought home 26 ribbons including four first place ribbons and three second place ribbons. This year the stock seat team had the largest number of beginner walk/trot riders with four riders showing for the first time in their show career bringing home a total of four beginner walk/trot ribbons including a first place ribbon by Shauna Burton at the Murray State University horse show. Both teams finished the season placing in the top ten overall in Zone 5, Region 1 of the Intercollegiate Horse Show Association.

Last year marked a "first" for the team having two former undergraduate team members, Katelyn Brumfield and Kristen Walters, come back to represent Mississippi State University in the alumni division. Alumni rider Katelyn Brumfield went on to place in the top ten in the nation in the alumni hunt seat flat division. Katelyn was the first Mississippi State University rider to represent Mississippi State University at nationals, but she was not the last. Both alumni riders continued to represent Mississippi State University during the 2010-2011 competition season making Mississippi State University the only Mississippi school represented in the alumni division. Katelyn Brumfield continued her success this year by placing first overall in the alumni flat division at the Maryville College horse show. In the alumni over fences division, Kristen Walters placed first overall at the Middle Tennessee State University horse show and tied for first overall at the Sewanee horse show. This successful showing helped Kristen qualify for Zones competition where she won her alumni over fences class making her the second Mississippi State University rider to qualify for nationals and the only rider from any Mississippi school to qualify for 2011 Intercollegiate Horse Show Association Nationals at the Kentucky Horse Park.


**Mississippi State University 2010-2011 Hunt Seat Team**

**Mississippi State University 2010-2011 Stock Seat Team and Assistant Coach John Williams**

## Implications

Reaching a decade of competition, the Mississippi State University equestrian team found this year to be a continuation of successes and changes. Last year's additions of alumni riders, regularly scheduled team riding lessons with designated practice outlets, new riding courses dedicated to riding practices for the team, and a newly developed team handbook really showed an impact this year finding a team that was stronger, organized, and continuing to find show success. The new addition this year of regular workouts outside of the riding lessons has brought about positive response by team members and will continue to be developed by head coach Dr. Molly Nicodemus and team captain Kristen Van Veldhuizen for this coming show season. New team captains have been announced for the 2011-2012 show season with Katie Downs and Tara Trask to replace former captains Ally Long and Samantha King. The new team captains and the coaching staff are working this summer to increase team membership through recruitment including increasing alumni riders.

# Mississippi State Horse Judging Team's Winning Tradition

**M. C. Nicodemus**
Department of Animal and Dairy Sciences, Mississippi State University, Mississippi State, MS

## Teaching Summary

In the fall of 2001 the Mississippi State University horse judging team started a tradition by competing for the first time at Morgan Grand Nationals Collegiate Judging Competition, and this year, the tradition continued with two teams from MSU competing. The 2010 horse judging teams followed in the footsteps of the winning 2009 teams that brought home a total of eleven individual top ten awards from Morgan Grand Nationals including multiple individual Grand Championship awards. The 2010 teams continued the winning tradition by racking up a total of eleven individual Top Ten awards and eight team Top Ten awards including Overall Individual Grand Champion and Overall Team Reserve Grand Champion.

## Introduction

After several years of Mississippi State University lacking representation at national horse judging competitions, in the fall of 2001 MSU returned to competition with their first appearance at Morgan Grand Nationals Collegiate Judging Competition. This fall will mark a decade of continuous participation in national horse judging competitions by teams from MSU with the return to Morgan Grand Nationals. Since 2001 the team has returned each year to Morgan Grand Nationals bringing home multiple ribbons with this past fall being one of the most successful years since their 2006 horse judging team, which won individual and team Grand Championships in every division. Weekly practices using judging videos, University horses, and local barns assisted in making the success of the 2010 MSU horse judging teams along with the support of Animal and Dairy Sciences faculty, former judging team members, graduate students, extension agents, and local horse owners.

## Procedures

The MSU horse judging teams coached by Dr. Molly Nicodemus, Associate Professor of Animal and Dairy Sciences, and ADS graduate students Mandy Arrington and Shannon Lindsey traveled this past fall to Morgan Horse Grand Nationals with two teams. The collegiate judging competition was a daylong event starting at 8 am where team members judged four in-hand classes and four performance classes. Morgan horses that were competing in the Morgan Grand Nationals Horse Show were used for the judging competition giving students a chance to judge horses that were ranked nationally in their respective show classes. After judging the eight classes, judging team members prepared four sets of oral reasons, two halter and two performance classes, to give to judging officials. Team members were scored on how well they placed the classes according to judging officials and how well they presented their oral reasons with a maximum score of 50 points for each class they placed and for each set of oral reasons they gave. The teams and team members were competing to win awards in the following divisions: Overall, In-Hand, Performance, and Reasons.

## Results

Both 2010 MSU horse judging teams won Top Ten Honors in the overall team division ranking sixth overall for one team and winning the Reserve Champion honor for the other team. In addition, in the overall individual division, Brianna Tisdale won third overall and Will Gentry was named Overall Individual Grand Champion. A MSU team member won the Individual Grand Champion title in every division at the contest with team members Will Gentry and Brianna Tisdale winning Top Ten Honors in every division. In the In-Hand division MSU teams won a ninth placing and a Reserve Championship with team member Paige Nicholson winning an individual eight placing, Will Gentry winning an individual fourth placing, and Brianna Tisdale winning Individual Grand Champion. In the Performance division MSU teams won a fifth placing and a Reserve Championship with team member Summer Walton winning an individual ninth placing, Brianna Tisdale winning an individual eighth placing, and Will Gentry winning Individual Grand Champion. In the Reasons division MSU teams won a ninth placing and a Reserve Championship with team member Reagan Bugg winning an individual tenth placing, Brianna Tisdale winning an individual fifth placing, and Will Gentry winning Individual Grand Champion.

## Implications

Marking a decade of competition, this fall (2011) two MSU horse judging teams will travel to Morgan Horse Grand Nationals with high expectations to continue the team's winning tradition under the coaching of Dr. Molly Nicodemus, Shannon Lindsey, and Mandy Arrington. The teams will continue a similar practice schedule as that of former teams including marking the third year the team has participated in an Arabian Horse Judging Clinic hosted by the First family of Starkville, Mississippi. The clinic is a daylong educational and practice clinic at the First family's Arabian farm where team members practice judging Arabian in-hand classes followed by giving oral reasons on the in-hand classes. During the clinic classes are critiqued by Patrick First, former MSU horse judging team member and nationally recognized Arabian horse trainer and rider, with team members having an opportunity to ask questions concerning characteristics unique to society-type horse breeds such as the Arabian and Morgan horses. Since the implementation of the clinic, MSU horse judging teams have seen an improvement in their in-hand and oral reasons scores. Additional clinics focusing on performance classes are currently being organized for the 2011 horse judging teams.

**2010 MSU Horse Judging Teams at Morgan Grand Nationals: Top Left to Right- Summer Walton, Will Gentry, Assistant Coach Mandy Arrington, Amanda McGraw, Katie Ashworth, and Paige Nicholson. Bottom Left to Right- Reagan Bugg and Brianna Tisdale**

# Survivability and Growth of Biophotonic *Escherichia coli* O157:H7 (ATCC 43888) with pAK1-lux and pXEN-13 Plasmids in Bovine Rumen and Fecal Fluid

**H. A. Duoss[1], J. R. Donaldson[2], T. R. Callaway[3], P. R. Broadway[4], J. M. Martin[1], J. A. Carroll[5], M. A. Ballou[4], S. M. Falkenberg[6], P. Ryan[1], S. Willard[7], K. Moulton[8], L. N. Bergeron[1] and T. B. Schmidt[1]**

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## Research Summary

The use of *Escherichia coli* O157:H7 transformed with photonic plasmids may provide a viable model for the real-time monitoring of various pre-harvest interventions on the colonization or shedding of *E. coli* O157:H7 within cattle. The objective of this study was to determine the growth and survivability of *E. coli* O157:H7 (ATCC 43888) transformed with the pAK1-*lux* or the pXEN-13 biophotonic plasmids within bovine rumen fluid and fecal fluid (33% v/v). *Escherichia coli* O157:H7 bacteria transformed with both photonic plasmids were grown in comparison to non-transformed *E. coli* O157:H7 (ATCC 43888) in rumen and fecal fluid media for 8 h in replicates of four with aliquots taken every h from 0 to 8 h. No differences were observed between the wild type parent strain ATCC 43888 ($P < 0.05$), *E. coli* O157:H7+pAK1-lux ($P > 0.18$) and *E. coli* O157:H7+pXEN-13 ($P > 0.16$) bacteria in regards to growth (percent change from 0 h) within rumen fluid media. There were no differences growth observed (percent change from 0 h) within fecal fluid media between the wild type parent strain ATCC 43888 ($P > 0.18$) and *E. coli* O157:H7+pXEN-13 ($P > 0.16$). Photonic emissions (reflective light units; RLU) were decreased ($P<0.001$) in *E. coli* O157:H7 pXEN-13 when compared to pAK1-*lux* plasmid in both rumen and fecal fluid media but both plasmids retained and exhibited luminescence. Growth of both *E. coli* O157:H7 biophotonic plasmids were not altered in comparison to the non-transformed wild type parent ATCC 43888, indicating these plasmids may serve as valid models for *in vivo* studies. While these results are promising, further research is needed to validate whether *E. coli* O157:H7 pAK1-*lux* and/or *E. coli* O157:H7+pXEN-13 can serve as models for pre-harvest pathogen interventions in cattle.

## Introduction

One of the most notorious foodborne pathogens is *Escherichia coli* O157:H7. Each year, *E. coli* O157:H7 and other related enterohemorrhagic *E. coli* (EHEC) cause approximately 93,000 human illnesses at an estimated cost to the U.S. economy of more

than $1 billion per year (Scharff, 2010; Scallan et al., 2011). Because *E. coli* O157:H7 is found as an asymptomatic resident of the gastrointestinal tract of cattle there is no outward visible indicator to identify carriers. Reducing populations in the live animal can have a significant impact with regard to improving human health and safety. Thus, there has been an increased effort associated with identifying novel pre-harvest intervention strategies to decrease populations of *E. coli* O157:H7 in cattle (Callaway et al., 2004; Sargeant et al., 2007; Oliver et al., 2008).

Various strategies have been employed by researchers and producers alike to attempt to reduce populations of *E. coli* O157:H7 prior to harvest, including nutritional manipulation, competitive exclusion through probiotics, and vaccinations. Although most of these methods have reduced the prevalence of *E. coli* O157:H7, they have not proven to be fully successful or economically viable (Callaway et al., 2009; Arthur et al., 2010; McNeilly et al., 2010). Therefore, researchers continue to investigate interventions that will reduce EHEC shedding or inhibit colonization of *E. coli* O157:H7 but there has been no confirmed method proven to date (Huffman, 2002).

One of the main limitations to the development of pre-harvest interventions has been the inability to physically track *E. coli* O157:H7 in a real-time fashion. At the 49$^{th}$ Reciprocal Meats Conference, Lohr (1996) summarized that potential sources of contamination on meat carcasses could be from fecal material, punctured stomach contents and animal hide and biophotonic tracking of this pathogen would be a valid model. The concept of biophotonics involves the introduction of a vector containing the *lux*CDABE operon, which encode enzymes responsible for synthesis of the luciferase enzyme and the aldehyde substrate (Meighen, 1993), into the bacterial strain of interest. The luciferase enzymes emit reflective light units, allowing the bacteria to be visualized in real-time with the use specialized camera equipment.

Biophotonic tracking of *E. coli* O157:H7 would provide researchers with a novel real-time model for tracking *E. coli* O157:H7, both pre- and post-harvest. Therefore, the objective of this study was to determine if the growth of *E. coli* O157:H7 (ATCC 43888) transformed with either the pAK1-*lux* or pXEN-13 plasmid was altered in bovine rumen fluid media or fecal fluid media compared to the non-transformed *E. coli* O157:H7. This study is a vital step in the verification of biophotonic *E. coli* O157:H7 as a novel real-time model.

## Procedures

*Collection of Rumen Content and Fecal Material.* Rumen content was collected from the rumen ventral sac of a 362 kg cannulated steer housed at the Leveck Animal Research Center. Fecal material was collected rectally from six Holstein cows at the Joe Bearden Dairy Research Center. Separately, ruminal and fecal contents were placed into nylon paint strainers and fluids and particles were separated as previously described (Leyendecker et al. 2004). After separation, rumen and fecal fluids were incubated at 37°C for 30 min to allow contents to separate into three visible layers. After incubation, the middle layer was removed and utilized for the media preparation.

*Bacterial Cultivation Conditions.* *Escherichia coli* ATCC 43888 is an O157:H7 serotype that does not possess the shiga toxins I or shiga toxin II genes

responsible for production of shiga toxins. This bacterium is routinely cultured on Tryptic Soy Agar (TSA; Difco Co., Corpus Christi, TX) at 37°C. The pAK1-lux and pXEN-13 plasmids (Caliper Life Sciences; Hopkinton, MA) and both are photonic plasmids that harbor the *luxCDABE* operon. For transformation of this bacterium with the plasmid pXEN-13, cells were washed three times with 10% glycerol and electroporated with 50 ng of plasmid. Using an electroporation method previously described by Moulton et al., 2008, *Escherichia coli* O157:H7 (ATCC 43888) was transformed with the plasmid pAK1-lux. Transformed *E. coli* O157:H7 were selected by growth on 50 ug/ml of ampicillin (AMP) at 37°C, followed by subsequent detection of bioluminescence.

*Rumen and Fecal Trials.* The *E. coli* O157:H7 (ATCC 43888) transformed with either the pAK1-*lux* plasmid or the pXEN-13 plasmid were analyzed for growth on rumen fluid media and fecal fluid media. Individual colonies from freshly streaked TSA plates (*E. coli* 43888) with 50 ug/mL AMP were used to inoculate 5 mL of tryptic soy broth in four replicates. Cultures were incubated with rotation (140 rpm) at 37°C until mid-log phase ($OD_{600}$ ~0.50; Broadway, 2011) was reached (Hewlett Packard 8452, Agilent Technologies, Palo Alto, CA). Cultures of each strain were then diluted 1:100 in 30 mL of either rumen or fecal media and incubated with rotation (140 rpm) at 37°C for 24 h. Aliquots of each strain were acquired at h 0, 1, 2, 3, 4, 5, 6, 7 and 8 of growth in both the rumen and fecal fluid media. Samples at each time point were serially diluted in 1X phosphate-buffered saline (PBS) and plated onto the appropriate media. Plates were then incubated at 37°C for 12 h prior to analysis. Simultaneously at each sampling time, 100 µL aliquots of each strain for each type of medium were transferred to a 96-well plate and subsequently imaged using a Berthold/Nightowl camera equipped with the WinLight 32 software, version 2.51.11901 (Berthold Technologies, Oak Ridge, TN). Photonic emissions were all imaged following a 10 min acquisition phase.

*Statistical Analysis.* Data were analyzed as a completely randomized design with repeated measures using PROC GLM in SAS (SAS Inst. Inc., Cary, NC). The experimental unit was defined as tube, and significance was declared at $P < 0.05$. Pair wise differences among least squares means at various sample times were evaluated with the PDIFF option of SAS.

## Results

Analysis of the $\log_{10}$ fixed effects indicated that there was a treatment by time interaction ($P < 0.04$) and a time effect ($P < 0.02$) with no treatment effect ($P < 0.10$) within rumen fluid media. In the analysis of the percent change from 0 h fixed effect there was no treatment by time interaction ($P < 0.69$) within rumen fluid media (Table 1). When comparing the $\log_{10}$ results, the parent strain ATCC 43888 with the transformed *E. coli* O157:H7+pAK1-lux there was fluctuation in growth at 2 h ($P < 0.03$), 3 h ($P < 0.02$) and 7 h ($P < 0.01$), but at 8 h was not significantly different ($P < 0.80$). When comparing ATCC 43888 with the transformed *E. coli* O157:H7+pXEN-13 there was a difference seen at 2 h ($P < 0.01$) and 8 h ($P < 0.02$). Comparing *Escherichia coli* O157:H7+pAK1-lux and *E. coli* O157:H7+pXEN-13 there was a difference observed at 7 h ($P < 0.04$) and 8 h ($P < 0.04$). Within $\log_{10}$, ATCC 43888 did have a fluctuation in growth from 0 h to 8 h ($P < 0.05$). There was a tendency for a difference in growth in *E. coli* O157:H7+pAK1-lux (*P*

< 0.10) and *E. coli* O157:H7+pXEN-13 ($P <$ 0.07). Although, there was a change in growth within the each individual *E. coli* O157:H7 bacteria, at 8 h all bacteria were not statistically different from each other.

**Table 1. Least squares means for growth of *Escherichia coli* O157:H7 within bovine rumen fluid media[a] at between the wild type parent strain *E. coli* O157:H7 (ATCC 43888), pAK1-*lux* and pXEN-13 plasmids over time (h)**

| | Treatment groups | | | *P*-values[j] | | |
|---|---|---|---|---|---|---|
| Hour | ATCC[b] 43888 | *E. coli*[c] pAK1-lux | *E. coli*[d] pXEN-13 | ATCC 43888[b] vs. pAK1-lux[c] | ATCC 43888[b] vs. pXEN-13[d] | pAK1-lux[c] vs. pXEN-13[d] |
| *Log*$_{10}$ | | | | | | |
| 0 h | 7.23[e] | 7.09[e] | 7.18[e] | 0.28 | 0.69 | 0.50 |
| 1 h | 7.19[ef] | 7.25[e] | 7.10[e] | 0.68 | 0.51 | 0.29 |
| 2 h | 7.47[g] | 7.15[ef] | 7.11[e] | 0.03 | 0.01 | 0.76 |
| 3 h | 6.97[fh] | 7.33[ef] | 7.12[e] | 0.02 | 0.29 | 0.15 |
| 4 h | 7.34[efg] | 7.20[ef] | 7.10[e] | 0.38 | 0.11 | 0.50 |
| 5 h | 7.08[efhi] | 7.13[e] | 7.19[e] | 0.69 | 0.41 | 0.67 |
| 6 h | 7.33[efgi] | 7.44[f] | 7.27[e] | 0.47 | 0.67 | 0.28 |
| 7 h | 6.84[hi] | 7.22[ef] | 6.93[f] | 0.01 | 0.51 | 0.04 |
| 8 h | 7.31[efgi] | 7.27[ef] | 6.98[ef] | 0.80 | 0.02 | 0.04 |
| *SEM* | 0.15 | 0.15 | 0.15 | | | |
| *P-value* | 0.05 | 0.10 | 0.07 | | | |
| *% Δ from 0 h* | | | | | | |
| 1 h | 2.19 | 3.83 | 1.12 | 0.34 | 0.54 | 0.12 |
| 2 h | 3.17 | 2.96 | 1.60 | 0.90 | 0.37 | 0.43 |
| 3 h | 3.74 | 2.73 | 1.74 | 0.59 | 0.25 | 0.60 |
| 4 h | 2.37 | 1.79 | 2.23 | 0.77 | 0.94 | 0.82 |
| 5 h | 4.08 | 1.54 | 1.68 | 0.15 | 0.17 | 0.93 |
| 6 h | 2.47 | 4.21 | 1.86 | 0.35 | 0.75 | 0.24 |
| 7 h | 5.49 | 3.60 | 3.50 | 0.28 | 0.25 | 0.95 |
| 8 h | 0.95 | 3.70 | 2.87 | 0.11 | 0.27 | 0.63 |
| *SEM* | 1.82 | 1.82 | 1.82 | | | |
| *P-value* | 0.69[k] | | | | | |

[a] Russell and Martin, 1984
[b] *Escherichia coli* O157:H7 wild type parent strain ATCC 43888
[c] *Escherichia coli* O157:H7+pAK1-lux
[d] *Escherichia coli* O157:H7+pXEN-13
[e, f, g, h, i] Means within a row different between treatment groups if $P \leq 0.05$
[j] *P*-value is comparison of growth between *Escherichia coli* O157:H7 bacteria
[k] *P*-value of fixed effect of the treatment by time interaction

All *E. coli* O157:H7 bacteria were analyzed in the percent change from 0 h as fixed effects. There was no treatment ($P < 0.34$), time ($P < 0.57$) or treatment x time interaction ($P < 0.69$) effects observed. This data suggests that the transformed biophotonic plasmids grew the same in comparison to the wild type parent strain, ATCC 43888.

***Fecal fluid media***. Analysis of the $\log_{10}$ fixed effects indicated that there was a treatment effect ($P < 0.001$) and a treatment x time interaction ($P < 0.01$) with a tendency for a time effect ($P < 0.06$) [Table 2]. Looking within the comparison of ATCC 43888 and *E. coli* O157:H7+pAK1-lux there was a difference in growth at 0 h ($P < 0.001$), 6 h ($P < 0.03$) with a tendency for difference in growth at 8 h ($P < 0.70$). $Log_{10}$ results comparing ATCC 43888 and *E. coli* O157:H7+pXEN-13 indicated that there was a fluctuation in growth at 0 h ($P < 0.02$), 2 h ($P < 0.005$), 4 h ($P < 0.02$) and at 7 h ($P < 0.01$). There was a difference in growth when comparing the two transformed *E. coli* O157:H7 bacteria with differences in growth from 1 h to 7 h, but no difference at the beginning of the trial at 0 h ($P < 0.25$) or the end of the trial at 8 h ($P < 0.18$). When analyzing the fixed effects from the percent change from 0 h there was a tendency for a treatment effect ($P < 0.07$) and no time ($P < 0.11$) or treatment x time interaction effect ($P < 0.49$) observed. These results suggest that the transformed biophotonic plasmids grew similar to the wild type parent strain, ATCC 43888.

***Photonic emissions***. Photonic emission were measured based on reflective light units (RLU's). Reflective light units are measured in photons/pixel per second (Ph/pix s). Within both rumen and fecal fluid photonic emissions were decreased ($P < 0.001$) in the pXEN-13 plasmid when compared to pAK1-*lux* plasmid (Table 3, Table 4). With regards to rumen fluid media *E. coli* O157:H7+pAK1-lux reached peaked RLU emission at 5 h (246.08 Ph/pix s) and held stable throughout the trial. *Escherichia coli* O157:H7+pXEN-13 reached peak RLU emissions at 8 h (9.02 Ph/pix s). Both *E. coli* O157:H7+pAK1-lux and *E. coli* O157:H7+pXEN-13 in fecal fluid media exhibited the greatest photonic emissions at 4 h pAK1-*lux* (455.49 Ph/pix s). *Escherichia coli* O157:H7+pXEN-13 reached peak photonic emissions at 3 h (6.32 Ph/pix s). Both plasmids did exhibit luminescence within each media and remained stable for the duration of the study. This signifies that the pAK1-*lux* and the pXEN-13 plasmids could potentially both serve as models for *in vivo* studies and future pre-harvest food safety research.

## Implications

Transformation of *E. coli* O157:H7 with the pAK1-*lux* gene cassette or the pXEN-13 gene cassette did not alter the stability or growth of the transformed *E. coli* O157:H7 (ATCC 43888) within rumen or fecal fluid media; there was no difference in growth from 0 h to 8 h within each *E. coli* O157:H7 bacteria. Both plasmids remained stable in regards to photonic emission and retained luminescence throughout the study. These results suggest that both plasmids could be implemented for a model for pre-harvest pathogen intervention in cattle.

**Table 2. Least squares means for growth of *Escherichia coli* O157:H7 within bovine fecal fluid media[a] at between the wild type parent *E. coli* O157:H7 (ATCC 43888) and pAK1-*lux* and pXEN-13 plasmids over time (h)**

| | Treatment groups | | | *P*-values[h] | | |
|---|---|---|---|---|---|---|
| Hour | ATCC 43888[b] | *E. coli* pAK1-lux[c] | *E. coli* pXEN-13[d] | 43888[b] vs. pAK1-lux[c] | 43888[b] vs. pXEN-13[d] | pAK1-lux[c] vs. pXEN-13[d] |
| *Log$_{10}$* | | | | | | |
| 0 h | 7.51[e] | 6.60[e] | 6.84 | < 0.001 | 0.002 | 0.25 |
| 1 h | 6.92[f] | 7.15[f] | 6.63 | 0.30 | 0.15 | 0.02 |
| 2 h | 7.36[e] | 7.18[f] | 6.77 | 0.37 | 0.005 | 0.05 |
| 3 h | 6.99[f] | 7.15[f] | 6.72 | 0.45 | 0.19 | 0.04 |
| 4 h | 7.03[f] | 7.34[fg] | 6.55 | 0.14 | 0.02 | < 0.001 |
| 5 h | 6.96[f] | 7.10[fg] | 6.65 | 0.51 | 0.13 | 0.03 |
| 6 h | 7.17[ef] | 7.64[g] | 6.87 | 0.03 | 0.14 | < 0.001 |
| 7 h | 7.29[ef] | 7.47[fg] | 6.70 | 0.38 | 0.01 | < 0.001 |
| 8 h | 7.31[ef] | 7.23[f] | 6.93 | 0.70 | 0.11 | 0.18 |
| *SEM* | 0.22 | 0.22 | 0.22 | | | |
| *P-value* | < 0.001 | < 0.001 | > 0.18 | | | |
| *% Δ from 0 h* | | | | | | |
| 1 h | 8.38 | 8.19[e] | 5.29 | 0.96 | 0.39 | 0.44 |
| 2 h | 7.96 | 8.82[e] | 3.28 | 0.81 | 0.20 | 0.13 |
| 3 h | 8.62 | 8.36[e] | 1.98 | 0.94 | 0.07 | 0.08 |
| 4 h | 7.59 | 11.32[ef] | 6.33 | 0.30 | 0.73 | 0.17 |
| 5 h | 7.88 | 9.78[e] | 6.33 | 0.60 | 0.67 | 0.34 |
| 6 h | 9.55 | 15.77[f] | 4.86 | 0.09 | 0.20 | 0.003 |
| 7 h | 5.74 | 13.19[e] | 1.93 | 0.04 | 0.29 | 0.003 |
| 8 h | 4.46 | 9.55[e] | 1.08 | 0.18 | 0.39 | 0.03 |
| *SEM* | 2.94 | 2.94 | 2.94 | | | |
| *P-value* | 0.49[i] | | | | | |

[a] Russell and Martin, 1984
[b] *Escherichia coli* O157:H7 wild type parent strain ATCC 43888
[c] *Escherichia coli* O157:H7+pAK1-lux
[d] *Escherichia coli* O157:H7+pXEN-13
[e, f, g] Means within a column different between treatment groups if $P \leq 0.05$
[h] *P*-value is comparison of growth between *Escherichia coli* O157:H7 bacteria
[i] *P*-value of fixed effect of the treatment by time interaction

**Table 3. Photonic emissions of *Escherichia coli* O157:H7+pAK1-lux and *Escherichia coli* O157:H7+pXEN-13 (RLU/s)[a] in bovine fecal fluid media[b] over time (h)**

| Hour | Treatment groups | | *P*-Value |
|---|---|---|---|
| | *E. coli*[c] pAK1-lux | *E. coli*[d] pXEN-13 | |
| 0 h | 90.94[e] | 3.59[f] | <0.001 |
| 1 h | 75.45[e] | 7.32[f] | <0.001 |
| 2 h | 66.53[e] | 6.03[f] | <0.001 |
| 3 h | 220.95[e] | 3.40[f] | <0.001 |
| 4 h | 226.88[e] | 2.52[f] | <0.001 |
| 5 h | 246.08[e] | 4.88[f] | <0.001 |
| 6 h | 213.55[e] | 7.77[f] | <0.001 |
| 7 h | 195.22[e] | 8.70[f] | <0.001 |
| 8 h | 187.33[e] | 9.02[f] | <0.001 |
| SEM[g] | 1.78 | 1.80 | |

[a] Berthold/Nightowl camera, WinLight 32 software, version 2.51.11901, Berthold Technologies, Oak Ridge, TN
[b] Russell and Martin, 1984
[c] *Escherichia coli* O157:H7+pAK1-lux
[d] *Escherichia coli* O157:H7+pXEN-13
[e, f] Means within a row different between treatment groups if $P \leq 0.05$
[g] Standard error of the means within treatment

**Table 4. Photonic emissions of *Escherichia coli* O157:H7+pAK1-lux and *Escherichia coli* O157:H7+pXEN-13 (RLU/s)[a] in bovine fecal fluid media[b] over time (h)**

| Hour | Treatment groups | | *P*-Value |
|---|---|---|---|
| | *E. coli*[c] pAK1-lux | *E. coli*[d] pXEN-13 | |
| 0 h | 48.21[e] | 2.52[f] | 0.36 |
| 1 h | 259.01[e] | 2.08[f] | < 0.001 |
| 2 h | 222.27[e] | 4.50[f] | < 0.001 |
| 3 h | 195.35[e] | 6.32[f] | < 0.001 |
| 4 h | 455.49[e] | 5.77[f] | < 0.001 |
| 5 h | 339.51[e] | 4.21[f] | < 0.001 |
| 6 h | 260.12[e] | 4.22[f] | < 0.001 |
| 7 h | 236.85[e] | 2.67[f] | < 0.001 |
| 8 h | 148.26[e] | 1.53[f] | < 0.001 |
| SEM[g] | 12.29 | 12.32 | |

[a] Berthold/Nightowl camera, WinLight 32 software, version 2.51.11901, Berthold Technologies, Oak Ridge, TN
[b] Russell and Martin, 1984
[c] *Escherichia coli* O157:H7+pAK1-lux
[d] *Escherichia coli* O157:H7+pXEN-13
[e, f] Means within a row different between treatment groups if $P \leq 0.05$
[g] Standard error of the means within treatment

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# Post-weaning Feeding Behavior of Newly Weaned Heifer Calves

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## Research Summary

Stress experienced by calves at weaning often culminates in poor post-weaning feed intake (FI) and growth performance. The objective of this study was to characterize the feeding behavior of calves post-weaning. Brahman x British heifers (n = 48) born in spring 2010 at the Brown Loam Branch Experiment Station in Raymond, MS were abruptly weaned from their dams at 200 d of age. Heifers were penned in one of two dry-lots and received ad libitum access to a high roughage diet offered in GrowSafe® bunks. Feeding behavior was monitored for 24-26 d post-weaning and BW was evaluated weekly beginning at weaning. Data were analyzed using mixed models with day as a repeated measure when applicable. The number and duration of daily meal events, the duration of daily head down time, and daily FI increased with time post-weaning ($P < 0.0001$). Body weight was similar for all time-points ($P = 0.32$). However, there was great variation in the number of days it took heifers to first approach the feed bunks, eat feed for the first time, eat feed consistently for at least 5 d, and consume enough feed to meet estimated NEm requirements. To account for this variation, pen, temperament score, and the proportion of Brahman influence were included in the statistical model. Brahman-influenced heifers were slower ($P < 0.03$) to attend the bunks, begin consuming feed, consistently consume feed, and consume enough feed to meet NEm requirements. However, there was no effect ($P > 0.10$) of breedtype on feeding behavior or FI over the course of the entire feeding period. These data suggest there is considerable variation in post-weaning feeding behavior, of which some can be attributed to breedtype. These data also highlight important considerations when utilizing newly weaned calves in feeding trials, especially those using GrowSafe® bunks or similar feeding systems, and when managing abruptly weaned calves from pasture environments into feedlot environments.

## Introduction

Although cattle may be exposed to a variety of stressors throughout their lifetimes, a particularly stressful period for calves often occurs in conjunction with weaning. The psychological stress of being removed from their dams is often compounded with the physical stresses of being worked through chutes and a head catch, being vaccinated, and being forced to abruptly switch to milk-free diets. The stressors associated with weaning compromise post-weaning feed intake (Hutcheson and Cole, 1986) and subsequent growth performance (Loerch and Fluharty, 1999). Therefore, understanding the feeding behavior of weaned calves is crucial to the development of strategies to successfully manage these calves. The objective of this experiment was to characterize the post-weaning feeding behavior and subsequent

growth performance of abrupt-weaned heifer calves using GrowSafe® technology.

## Procedures

Brahman x British heifer calves (n = 48) were obtained from the spring 2010 calf crop at the Brown Loam Branch Experiment Station of Mississippi State University. Calves were evaluated for exit velocity (EV; Burrow et al., 1996) and pen score (PS; Hammond et al., 1988) 28 d prior to weaning. A temperament score (TS) was derived for each calf as the average of EV and PS. Calves were abruptly weaned from their dams at approximately 200 d of age (150- to 246-d range) and 480 lb of BW (308- to 608-lb range). Heifers were blocked by BW (obtained 28 d pre-weaning), TS, and proportion of Brahman influence (5 to 50%) and were assigned to one of two pens. Heifers received ad libitum access to water and a high roughage diet (13.8% CP and 52.1% TDN; comprised of 70% cottonseed hull pellets, 15% whole corn and 15% pelleted premix). Feed was continually offered in four GrowSafe® bunks (GrowSafe Systems Ltd., Airdrie, Alberta, Canada; Figure 1) in each of two pens to monitor calf feeding behavior for 24 to 26 d post-weaning. Heifer BW was recorded weekly beginning at weaning.

**Figure 1. GrowSafe® feeding bunks in one of two pens at Brown Loam Branch Experiment Station, Raymond, MS**

As heifers had not previously been allowed access to grain or a feed bunk, feeding landmarks of interest were: a) first bunk attendance, b) first feed consumption, c) consistent feed consumption, and d) attainment of NEm requirement. Feeding behavior traits monitored were: a) daily meal events (number and duration), b) daily head down time, and c) daily feed intake. These feeding landmarks and behavior traits are described in Table 1. Feeding behavior and BW data were analyzed using mixed models (SAS, 2002) with day post-weaning included as a class variable. Considerable variation was noted for all feeding landmarks and behavior traits. As such, feeding landmarks and behavior traits were analyzed using mixed models (SAS, 2002) with pen (and day for feeding behavior traits) included as a class variable and TS and the proportion of Brahman influence

included as linear covariates in an attempt to account for the variation.

**Table 1. Descriptions of feeding landmarks and feeding behavior traits**

| Feeding Landmark | Description |
|---|---|
| First bunk attendance | The day post-weaning when the heifer first attends the feed bunk. |
| First feed consumption | The day post-weaning when the heifer first consumes feed from the feed bunk. |
| Consistent feed consumption | The day post-weaning when the heifer begins consuming feed for a minimum of 5 consecutive days. |
| Achievement of $NE_m$ requirement | The day post-weaning when the heifer consumes enough feed to meet her $NE_m$ requirement as estimated by the NRC (1996). |
| **Feeding Behavior Trait** | |
| Meal event | The presence of the heifer at the feed bunk(s) without more than a 5 minute absence from any bunk in the pen. |
| Head down time | The amount of time the heifer's head is in the bunk during a meal event. |
| Feed intake | The total amount of feed consumed by the heifer daily. |

## Results

Considerable variation existed for the number of days to achieve each feeding landmark (Table 2). It is important to note that some heifers did not reach these milestones within the time-frame of the experiment. As these heifers were not losing appreciable BW or condition, the electronic ear tags used to identify their presence at the GrowSafe® bunks were removed from the calves' ears and checked for functionality. All tags were deemed to be working properly; therefore, it is likely that the heifers were not consuming feed from the bunks. Although these heifers could possibly have been consuming grain pushed out of the bunks onto the ground by other heifers, this was not observed. Furthermore, the level of feed in the bunks was controlled so that heifers had to place their heads down into the bunk to consume grain. This reduced the likelihood of heifers pushing grain out of the bunks and facilitated a good read on the electronic ear tags. It is possible, however, that these heifers were foraging on very small amounts of grass that sprouted in the pens.

**Table 2. Descriptive statistics of days to attain feeding landmarks (n = 48 heifers)**

| Feeding Landmark | Mean | SD | Minimum | Maximum | No. of Heifers Failing to Achieve Landmark |
|---|---|---|---|---|---|
| First bunk attendance (d) | 3.9 | 4.1 | 0 | 21 | 1 |
| First feed consumption (d) | 5.1 | 5.0 | 0 | 26 | 1 |
| Consistent feed consumption (d) | 8.3 | 6.2 | 0 | 26 | 3 |
| Attained $NE_m$ requirement (d) | 10.7 | 4.6 | 3 | 21 | 4 |

Neither pen nor temperament score affected any feeding landmarks ($P \geq 0.21$). However, as the proportion of Brahman influence increased, the heifers took longer ($P < 0.03$) to attain each feeding landmark. The number (Figure 2) and duration (Figure 3) of meal events, duration of head down time (Figure 4), and feed intake (Figure 5) increased ($P < 0.0001$) with day post-weaning. However, BW was similar ($P = 0.32$) across time post-weaning (Figure 6).

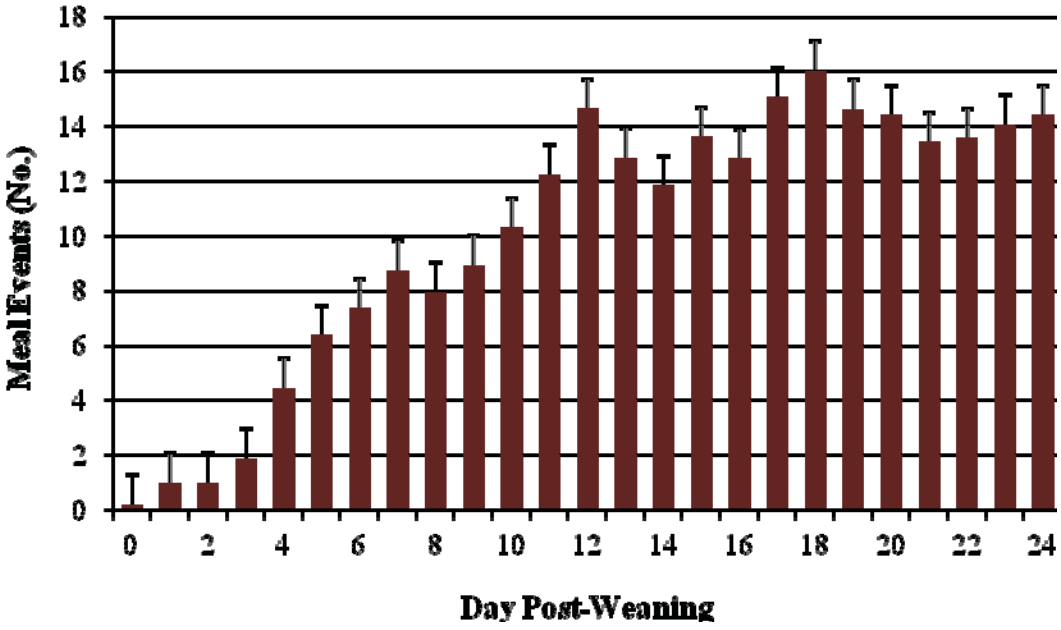


**Figure 2. Mean (+SE) number of daily meal events by day post-weaning (n = 48 heifers)**

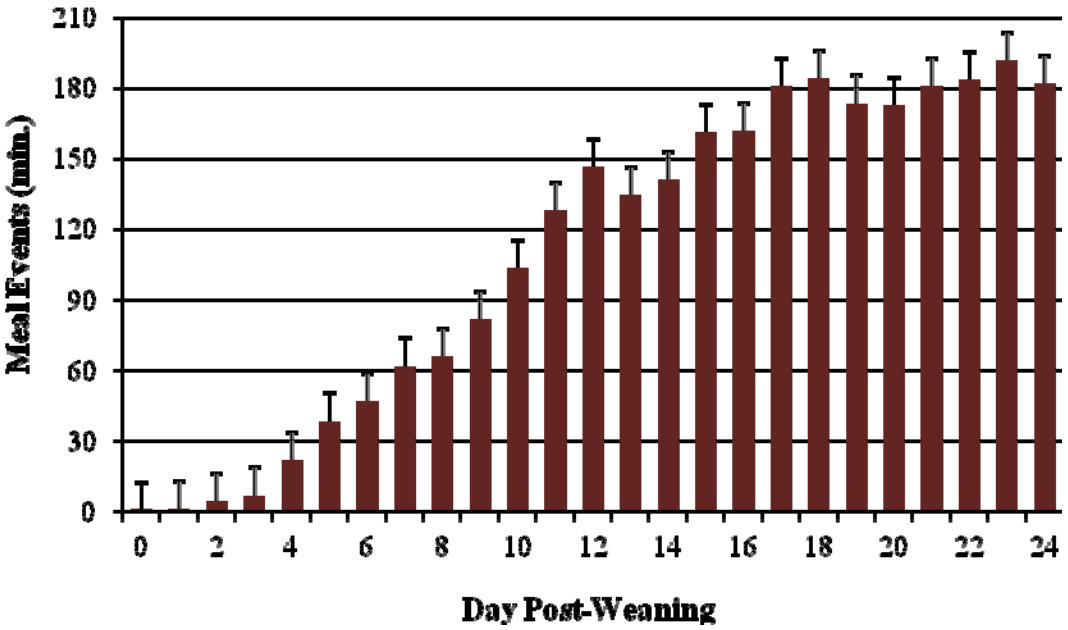


**Figure 3. Mean (+SE) duration of daily meal events by day post-weaning (n = 48)**

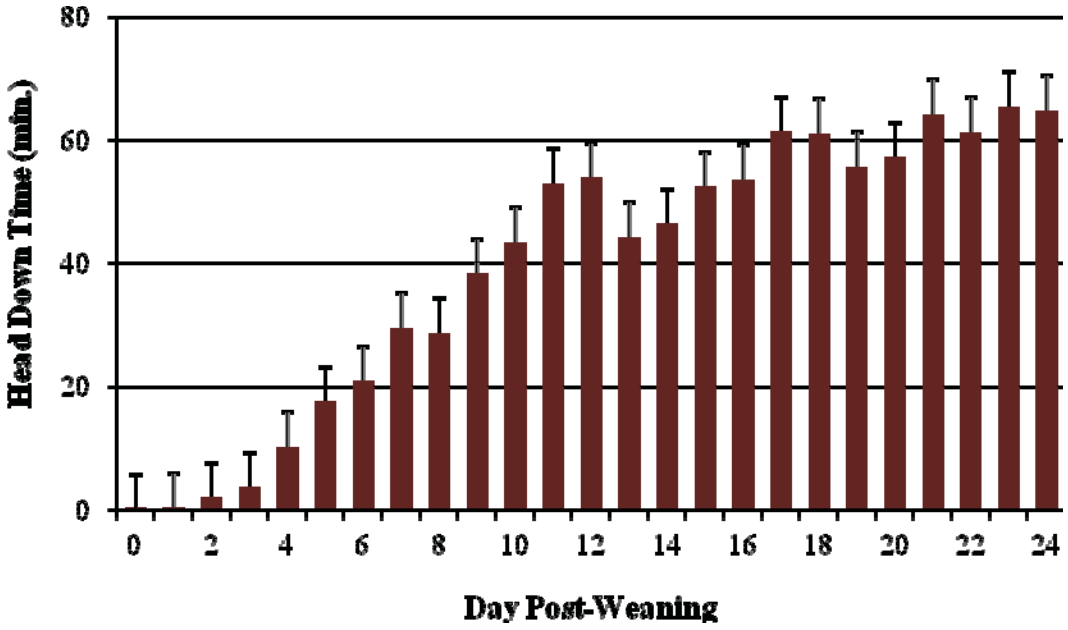


**Figure 4. Mean (+SE) duration of daily head down time by day post-weaning (n = 48)**

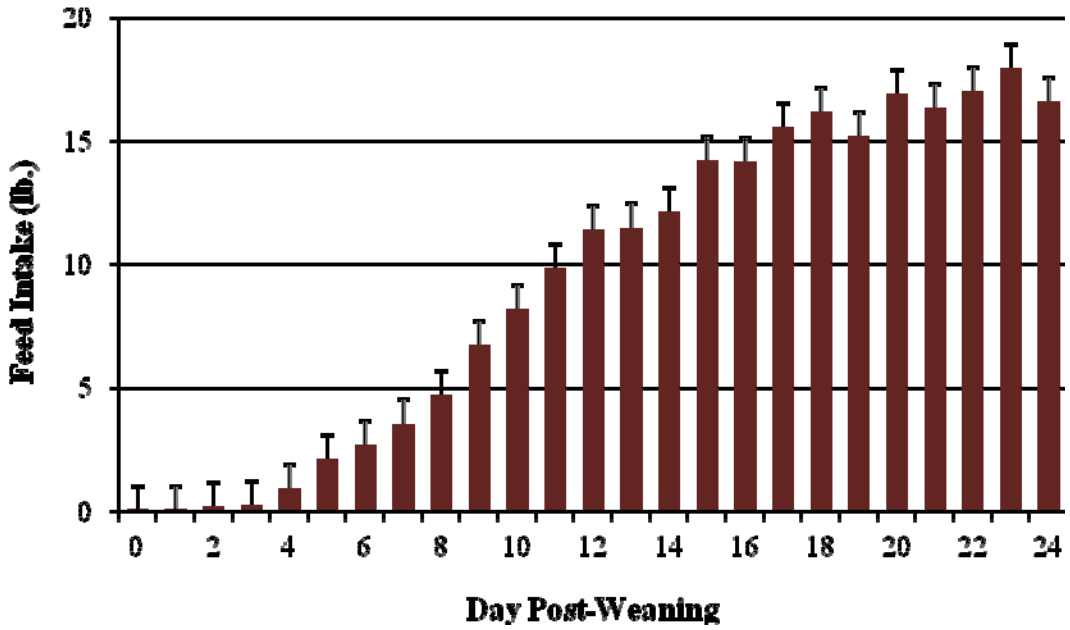


**Figure 5. Mean (+SE) daily feed intake (as-fed) by day post-weaning (n = 48)**

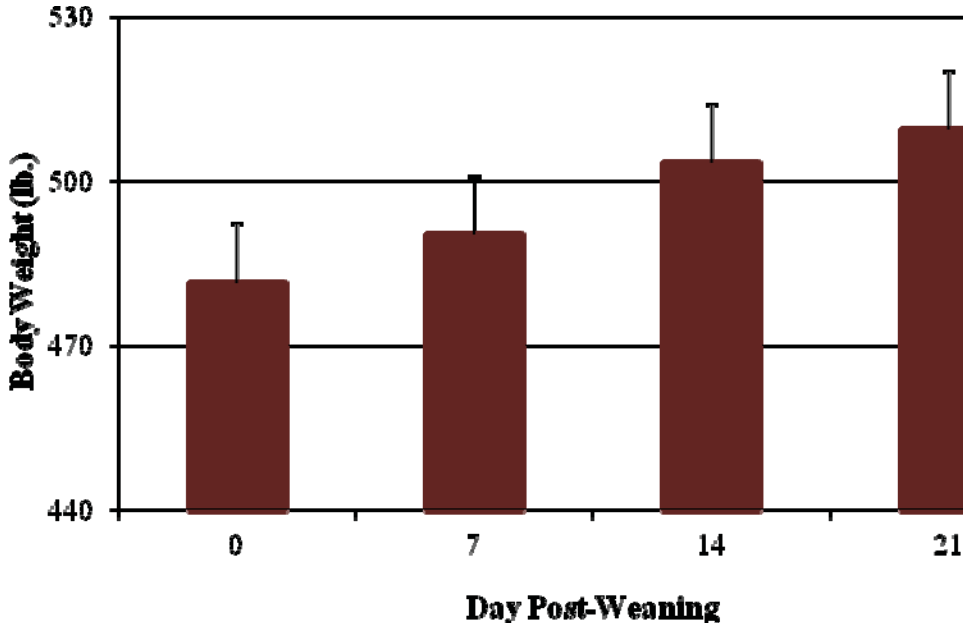


**Figure 6. Mean (+SE) body weight by day post-weaning (n = 48)**

Pen did not affect ($P \geq 0.21$) any feeding behavior trait. Temperament score did not affect the number of daily meal events; however, as TS increased, duration of meal events, duration of head down time, and feed intake decreased ($P < 0.002$). Furthermore, as the proportion of Brahman influence increased, all feeding behavior traits decreased ($P < 0.0001$). When each feeding behavior trait was expressed as the sum of daily events for each heifer for the duration of the experiment, pen, TS, and the proportion of Brahman influence failed to affect any feeding behavior trait ($P > 0.10$).

## Implications

Considerable variation exists in post-weaning feeding behavior of Brahman x British heifer calves not previously exposed to grain-feeding in bunks. Some of this variation can be attributed to breedtype and calf temperament, especially during the initial days when calves are adjusting to the bunks and diet. It appears that more temperamental heifers and heifers with a greater proportion of Brahman influence take longer to acclimate to consuming feed from GrowSafe® bunks. However, the impacts of temperament and Brahman influence on feeding behaviors were eliminated by 26 d post-weaning. These data highlight important considerations when utilizing newly weaned calves in feeding trials that utilize GrowSafe® bunks or similar feeding systems and when managing abruptly weaned calves from pasture environments into feedlot environments.

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# Effect of Temperament on Response to Cannulation and Glucose Challenge in Crossbred Beef Heifers

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## Research Summary

The objective of this study was to determine the effects of temperament on blood glucose and insulin following a stressor and a subsequent glucose challenge. Angus crossbred heifers (n = 37) were evaluated for temperament, and the 6 calmest and 6 most temperamental heifers (average weight = 585 lb) were fitted with jugular cannulas and placed in individual stalls. Blood was collected at cannulation and then via cannula at 0, 30, 60, and 90 min. Following 90 min, dextrose was infused via the cannula at 0.5 mL/kg BW. Blood samples were collected at -5, 0, 10, 15, 20, 30, 40, 60, 80, 100, 120, 140, 160, 180 min after challenge. A repeated measure ANOVA was conducted using the MIXED model procedure of SAS for analysis of temperament group, time, and their interactions on cortisol, insulin and glucose concentrations. Peak insulin concentration, time to peak, glucose disappearance and time to half life were analyzed using GLM procedures of SAS. During cannulation there was a significant effect of temperament on concentrations of glucose ($P = 0.05$) and insulin ($P = 0.05$), but not for cortisol ($P > 0.05$). There was no temperament by time interaction for glucose, insulin, or cortisol during cannulation. Cortisol had a strong tendency ($P = 0.06$) to be greater in temperamental heifers throughout the glucose challenge. Glucose concentrations were not significantly different between temperaments, but temperamental heifers had a greater concentration of glucose at half-life ($P = 0.05$), even though glucose disappearance was similar ($P = 0.78$). Peak insulin concentrations for the calm and temperamental heifers were 27.5 ± 13 and 62.5 ± 13 mIU/mL. Insulinogenic index was not affected by temperament, nor was there a temperament by time interaction for any variables. These data indicate that temperament has an impact on cortisol secretion following cannulation stress, which resulted in elevated glucose and insulin concentrations. Temperament appears to modify metabolic regulatory responses to a metabolic challenge in heifers.

## Introduction

Temperament in cattle has been described as a fear or avoidance response to human interaction (Fordyce et al., 1988b; Murphy et al., 1994). Temperament has been found to adversely alter many aspects of beef production such as: reproduction, feed efficiency, immune function, and carcass traits. Cattle exhibiting excitable temperaments have been reported to have higher concentrations of stress related hormones (Curley et al., 2006; 2008) , lower ADG (Voisinet et al.,

1997a ; Fell et al., 1999), lower dressing percentages and body condition scores (Petherick et al., 2002), higher incidence of dark cutters (Voisinet et al., 1997b), and compromised immunity (Fell et al., 1999).

Cortisol is a glucocorticoid and plays a major role in metabolism due to its ability to influence glucose synthesis and use. Glucose tolerance tests assess the response of insulin to an infusion of an exogenous source of glucose. This test could be exploited to help understand the utilization of glucose in temperamental versus calm cattle, giving important insight into the allocation of energy and possibly partially explaining why temperamental animals do not perform as well as calm animals. Therefore, our objective was to determine the effects of temperament on blood glucose and insulin, following a stressor and a subsequent glucose challenge.

## Procedures

Angus crossbreed heifers (n= 37) at the Brown Loam Experiment Station in Raymond, MS were weighed, pen scored, and exit velocity at weaning was recorded. Pen scores were assessed by an experienced observer at weaning. Three to five animals were placed in a pen and assigned a 1to 5 score according to their reaction to the observer, as described by Hammond et al. (1996). Exit velocity was obtained as animals were released from the chute. Exit velocity was calculated as the distance (1.83 m) traveled per second upon exiting the squeeze chute, as described by Burrow et al. (1988). Exit velocity and pen score were then combined and averaged for each animal as temperament score. From those observations, temperament scores were assigned and the 6 most temperamental and the 6 calmest heifers (average weight = 585 lb) from the weaning group were utilized for the glucose tolerance test. The average temperament scores for calm and temperamental heifers were 1.86 and 4.2, respectively.

In order to incorporate all 12 heifers, the glucose challenge took place two days, with 6 animals each day. Animals were randomly assigned to a day, with three calm and three temperamental calves on each of the two days. Each night the calves to be observed the next morning had access to water, but were fasted for 12 h prior to cannulation. In order to monitor the difference in stress response between temperaments, blood samples were collected during the pre-challenge period (cannulation) and then also throughout the glucose challenge.

Day one (n = 6) heifers were fitted with jugular cannulas to allow for blood collection. At each sampling, one 10 mL EDTA tube and one 10 mL no additive tube for serum was collected from each animal. Pre-challenge blood samples were taken: initial, jugular (when the jugular was punctured), and test (as the cannula was checked for functionality). The heifers were allowed to rest for 1.5 h. Blood samples were collected at 30, 60, and 90 minutes after completion of cannulation. After the rest period (2 h total) a blood sample was collected at -5 and 0 minutes, relative to glucose infusion. After the sample was collected at time 0, a 50% dextrose solution was infused at 0.5 mL/kg BW via the jugular cannula. Time 0 was used as a baseline concentration of cortisol,

glucose, and insulin. Following infusion blood samples were collected at 10, 15, 20, 30, 40, 60, 80, 100, 120, 140, 160 and 180 min. Following collection an equivalent volume of sterile saline was replaced via the cannulas, followed by heparinized saline to keep the cannula patent. At completion of the glucose challenge cannulas were removed and heifers were returned to their original pens. The next day the remaining six heifers were cannulated, rested, challenged and sampled following the same protocol as the procedures described previously.

Blood samples were centrifuged at 2800 RPM for 25 minutes at 39º F. Plasma was centrifuged within 30 minutes of collection and serum tubes were allowed to clot over night before centrifugation. Concentrations of insulin and cortisol were determined by RIA utilizing the commercially available Coat-A-Count kit (Siemens Healthcare Diagnostic, Los Angeles, California). Concentrations of glucose were determined by colorimetry utilizing the manual protocol of the commercially available Autokit Glucose (Wako Chemical USA, Inc., Richmond, VA).

A repeated measure ANOVA was conducted using the MIXED model procedure of SAS (2002) for analysis of temperament group, time, and their interactions on cortisol, insulin and glucose concentrations. Insulinogenic index was calculated by dividing the concentration of insulin by the concentration of glucose (I/G) at each time point a sample was collected. Insulinogenic index was then analyzed using repeated measures ANOVA MIXED model procedure of SAS (2002). Time to peak concentration and peak concentration of insulin and half-life concentration and time to glucose half-life were determined using GLM procedure of SAS (2002).

## Results

During the cannulation period temperamental heifers had numerically higher concentrations of cortisol ($P > 0.05$), which remained elevated over the course of the cannulation period. Temperamental heifers had greater ($P = 0.05$) concentrations of insulin and a strong tendency to have greater concentrations of glucose ($P = 0.05$). There was no time by temperament interactions for cortisol, glucose, or insulin during the cannulation period.

Heifers that were more temperamental tended to have higher concentrations of cortisol ($P = 0.06$) (Figure 1) throughout the glucose challenge. There was no difference in glucose concentrations between temperaments (Figure 2), however temperamental heifers had greater ($P = 0.05$) glucose half-life concentrations. There was no difference in the time it took to reach glucose half-life between temperaments. Insulin concentrations tended ($P = 0.07$) (Figure 3) to be greater in temperamental heifers, but there was no difference in peak insulin concentration or the time to peak insulin concentration between temperaments. Peak insulin concentrations (mIU/mL) for the calm and temperamental heifers were 27.5 ± 13 and 62.5 ± 13, respectively. There was no statistical difference in insulinogenic index between temperaments, although temperamental heifers had a numerically higher insulinogenic index (Figure 4). This indicates that the insulin response

to glucose challenge is more sensitive to the concentration of glucose present in temperamental heifers. There was no significant time by temperament interactions for cortisol, glucose, insulin, or insulinogenic index throughout the glucose challenge.

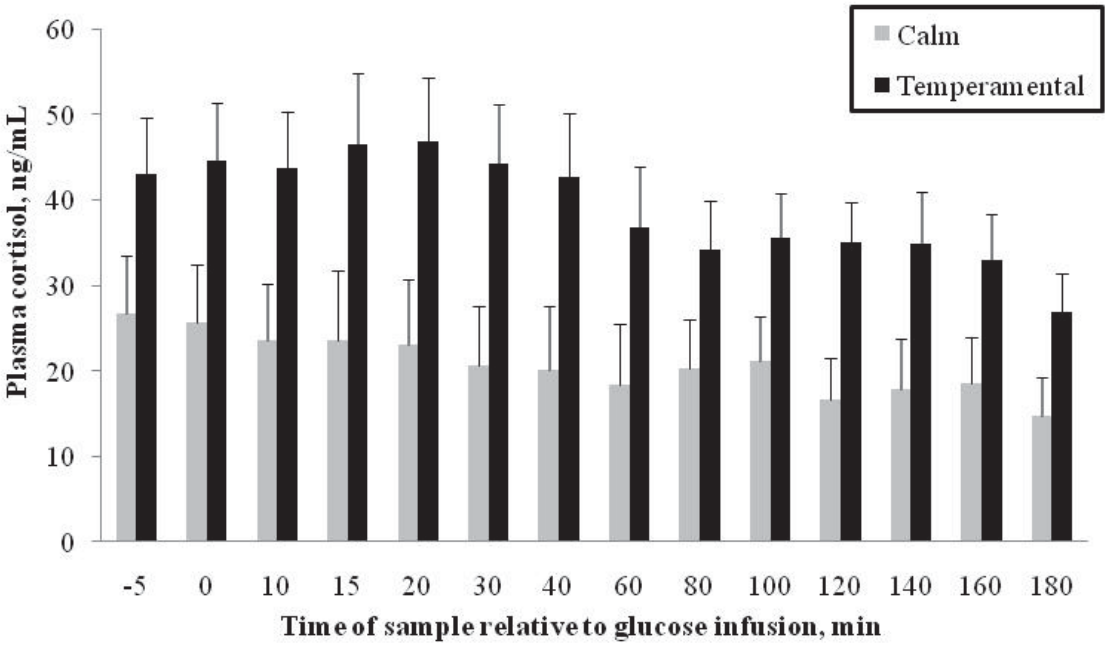


**Figure 1. Cortisol concentrations for the duration of the glucose challenge (3 h) in calm (grey) or temperamental (black) crossbred heifers. Temperament effect (*P* = 0.06), time effect (*P* < 0.01), temperament x time effect (*P* = 0.26). Mean SEM = 6.37.**

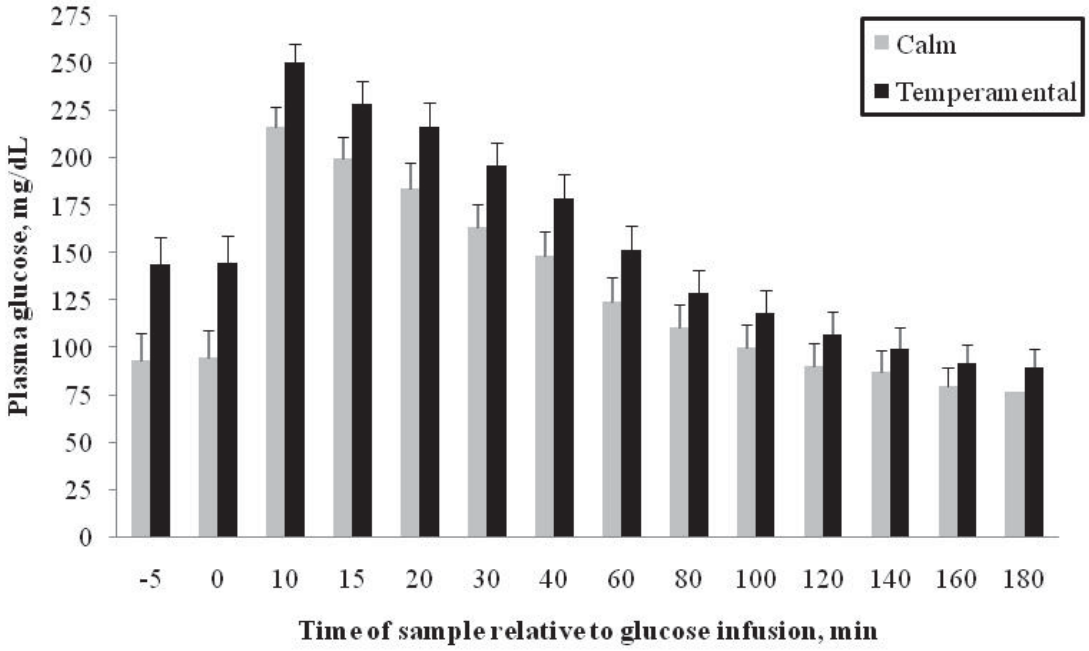


**Figure 2. Glucose concentrations for the duration of the glucose challenge (3 h) in calm (grey) or temperamental (black) crossbred heifers. Exogenous glucose (0.5 mL/kg BW) infused at 0 min. Temperament effect (*P* = 0.12), time effect (*P* < 0.01), temperament x time effect (*P* = 0.01). Mean SEM = 12.17.**

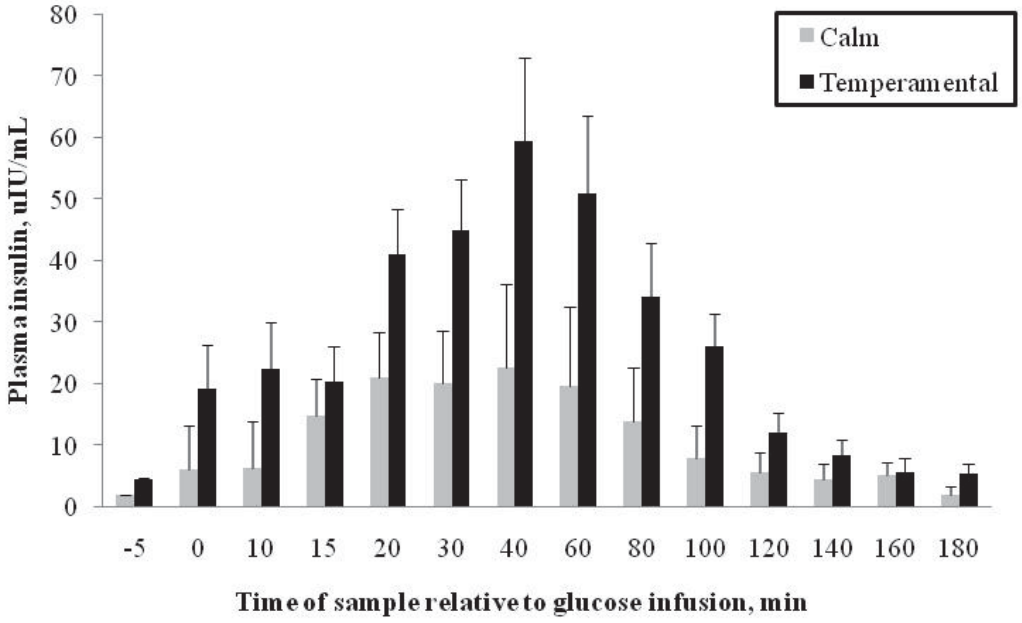


**Figure 3. Insulin concentrations for the duration of the glucose challenge (3h) in calm (grey) or temperamental (black) crossbred heifers. Temperament effect (*P* = 0.07), time effect (*P* < 0.01), temperament x time effect (*P* = 0.11). Mean SEM = 6.16.**

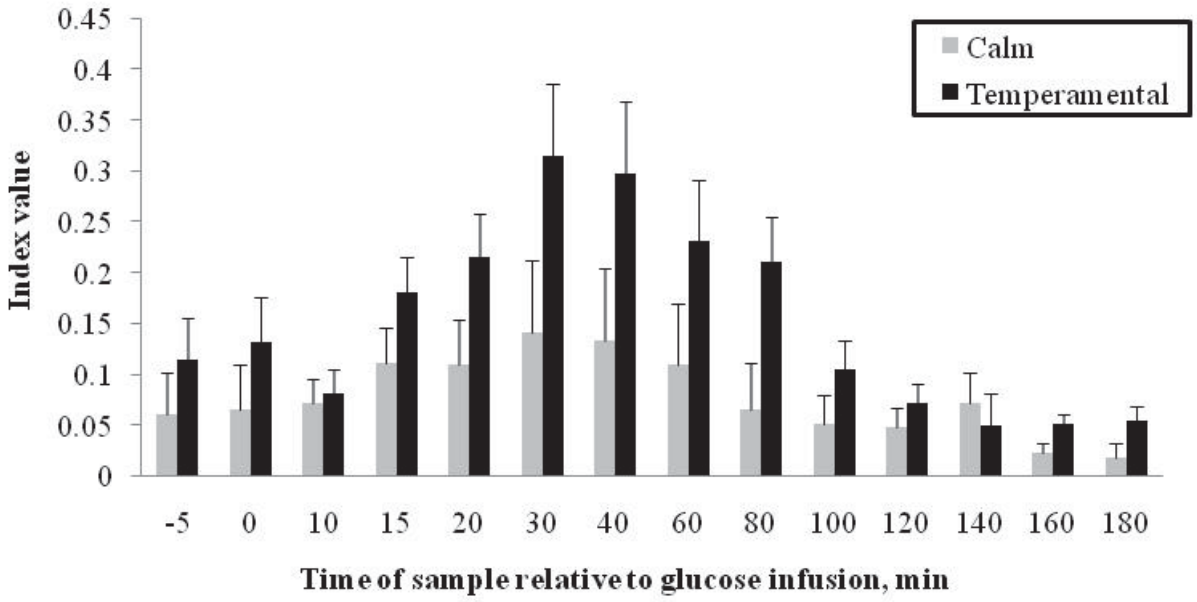


**Figure 4. Insulinogenic index values for calm (grey) and temperamental (black) crossbred heifers. Temperament effect (*P* = 0.12), time effect (*P* < 0.01), temperament x time effect (*P* = 0.06). Mean SEM = 0.04.**

## Implications

Temperamental cattle have greater concentrations of cortisol which remain elevated when stressed. Cattle that are more temperamental also have higher concentrations of glucose in their blood and possibly less stored in their fat and muscle tissues or liver. This may suggest that temperamental cattle do not utilize glucose as well as calm animals and may partially explain the lower performance of temperamental cattle.

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# Exposure of Beef Females to the Biostimulatory Effects of Bulls Prior to AI

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## Research Summary

In order to evaluate the biostimulatory effect of bull exposure on expression of estrus and pregnancy rate to artificial insemination (AI), Angus, Charolais, Hereford, and crossbred heifers (n = 86) and cows (n = 193) were assigned to one of three treatments: 1) no bull exposure (CON; n = 95), 2) exposure to a bull with a surgically deviated penis for 21 d prior to AI (SB; n = 88), or 3) exposure to a vasectomized bull for 21 d prior to AI (VB; n = 96) during the fall breeding seasons of 2009 and 2010. Ten days prior to and at the initiation of treatments, blood samples were taken to determine cyclicity. Body condition scores of the cows and weights of the heifers were also recorded at the initiation of treatments. The estrous cycles of all females were synchronized using the Select Synch + CIDR protocol. Treatments ceased at the time of AI. Pregnancy was determined by transrectal ultrasonography at 35 days post AI. At the onset of the experiment, 75.7% of heifers and 86.1% of cows were cycling. The percentages of females that displayed estrus were similar ($P > 0.05$) among treatments (70.5, 77.3, and 72.9% for CON, SB, and VB, respectively) but increased ($P < 0.05$) in heifers exposed to SB treatment compared to VB treatment and control (96.3, 73.8, and 69.7%, respectively). Pregnancy rates were also increased ($P < 0.05$) in females in the SB treatment (59.1%) compared to females treated in the VB treatment (40.6%) with the control group intermediate (49.5%). In conclusion, biostimulation did not have an effect on the expression of estrus but females exposed to the SB treatment had an increased pregnancy rate, with heifers having a greater response to bull exposure than cows.

## Introduction

Reproduction is the primary factor influencing the efficiency of beef cattle production (Short et al., 1990) with reproductive failure as the main source of economic loss in the cattle industry (Perry et al., 2010). The failure of reproduction associated with the period of anestrus has the most significant impact on the productivity and profitability of a cattle operation. In the development of heifers, age at which puberty occurs influences lifetime production efficiency. In the management of cows, the most important factor to increase reproductive efficiency is the early onset of estrus after calving (Hornbuckle et al., 1995). Prolonged postpartum anestrus in cows is a major cause of failure to rebreed in a breeding season (Short et al., 1994) and overcoming an extended postpartum interval allows for the achievement of optimum pregnancy rates through the use of estrus synchronization and incorporation of AI (Larson et al., 2006).

The use of AI is an economically advantageous method to improve the genetics of a herd (Larson et al., 2009) and estrus synchronization provides an efficient method to incorporate AI into a production system (Larson et al., 2009).

Synchronization increases the proportion of females that become pregnant early in the breeding season which results in a shorter calving season and an older, more uniform calf crop that is heavier at weaning (Dziuk and Bellows, 1983; Larson et al., 2006; Perry et al., 2010).

Management strategies, including biostimulation, that increase the success of estrus synchronization by inducing an ovulatory response in non-cycling females will improve fertility and increase genetic progress (Patterson et al., 2010). Heifers exposed to a vasectomized bull attained puberty 3.3 months earlier than non-exposed heifers (Rekwot et al., 2001). In cows, the presence of bulls decreased the postpartum interval to estrus and increased the number of primiparous cows that cycled before the beginning of the breeding season (Custer et al., 1990; Fernandez et al., 1993; Fike et al., 1996). Conception rates after a 21-d breeding season using AI were also greater for cows exposed to bulls before the breeding season when compared to cows not exposed (Berardinelli, 1987; Fernandez et al., 1993).

Therefore, the objective of this experiment was to evaluate the biostimulatory effects of bull exposure, either with or without the deposition of seminal plasma, on the expression of estrus and pregnancy rate to AI in cattle.

## Procedures

Animal care, handling, and protocols used in this study were approved by the Mississippi State University Institutional Animal Care and Use Committee. Angus, Charolais, Hereford, and crossbred heifers (n = 86) and cows (n = 193) were used in this experiment and were managed at the Leveck Animal Research Center at Mississippi State University during the fall breeding seasons (November 15 to January 15) of 2009 and 2010. The average d postpartum at breeding were 93 d with a range of 54 to 139 d. The average parity of cows was 3.48 ± 1.49 (mean ± SD) with a range of 2 to 9. The mean body condition score (scale of 1 to 9; Whitman, 1975) of cows during Year 2, at the initiation of treatments (d 0), were 5.8 with a range of 5 to 7. The weights of heifers did not significantly differ between years of the experiment, averaging 823.6 ± 116.6 (mean ± SD) lbs with a range of 550 to 1096 lbs. However, the range was greater in Year 1 (minimum of 550 lbs and maximum of 1096 lbs) than in Year 2 (minimum of 722 lbs and maximum of 960 lbs).

Heifers and cows were sorted into separate groups, stratified by breed and then randomly assigned to 1 of 3 treatment groups: 1) no bull exposure (CON; n = 95), 2) exposure to a bull with a surgically deviated penis for 21 d prior to AI (SB; n = 88), or 3) exposure to a vasectomized bull for 21 d prior to AI (VB; n = 96). Females in the SB treatment were exposed to the physical presence and pheromones of the bull but intromission was not physically possible while females exposed to the VB treatment were exposed to similar pheromones and intromission and the deposition of seminal plasma (but no spermatozoa) were possible. Bulls were fitted with chin-ball markers and expression of estrus by all females was detected during the treatment period (21 d) preceding AI. The experimental timeline is depicted in Figure 1.

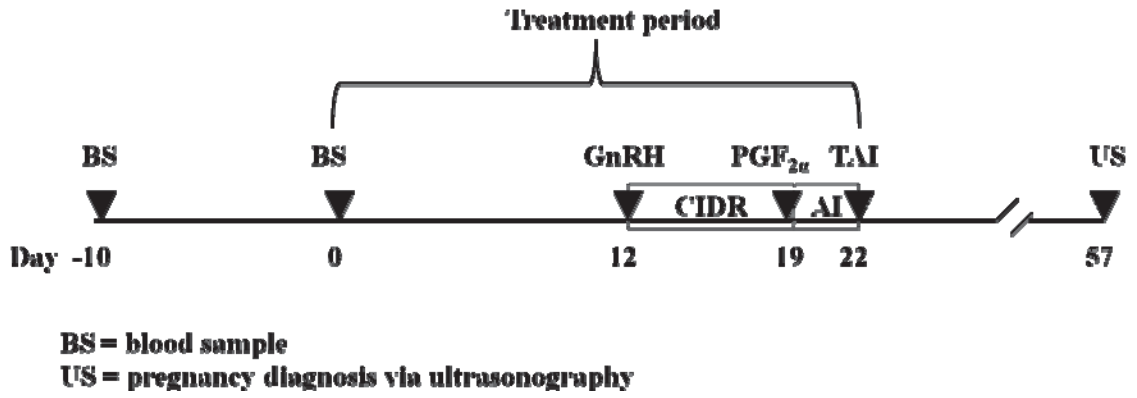


**Figure 1. Experimental protocol including sampling and synchronization schedule**

Two blood samples were collected prior to initiation of treatments and analyzed for concentrations of progesterone to determine cyclicity. The animal was considered to be cycling at the initiation of treatment when at least 1 blood sample contained a concentration of progesterone ≥ 1 ng/mL (Perry et al., 1991). Ovulation was synchronized with the Select Synch + CIDR protocol and concluded with TAI (Larson et al., 2006). Briefly, females received a controlled internal drug release (CIDR; Pfizer Animal Health, New York, NY) vaginal insert and an injection of GnRH (100 mg, i.m.; Cystorelin; Merial Limited, Duluth, GA) on d 12. On d 19, the insert was removed and animals received an injection of PGF2α (25 mg, i.m.; Lutalyse; Pfizer Animal Health), followed by visual detection of estrus 3 × daily with the addition of heatmount detectors (Estrotect Heat Detector, Spring Valley, WI). Animals observed in standing estrus or with an activated patch and secondary signs of estrus were inseminated approximately 12 h later. Animals not observed in estrus by 82 h post-PGF2α received a second injection of GnRH and TAI.

Pregnancy was diagnosed by transrectal ultrasonography (5-MHz intrarectal transducer, Aloka 500V, Corometrics, Wallingford, CT) on d 35 post-TAI to determine the presence of a viable embryo.

Procedure GLIMMIX of SAS (SAS Inst. Inc., Cary, NC) was used to analyze data including cyclicity status, expression of estrus, and pregnancy rate. Least square means were analyzed and separated when a protected F test of $P \leq 0.05$ was detected.

## Results

*Cyclicity*

At the onset of the experiment, 75.7% of heifers and 86.1% of cows were cycling. Cyclicity status between treatments did not differ ($P > 0.05$) between Year 1 and 2 of the experiment. Weights of heifers between years were also similar for Year 1 and 2 ($P > 0.05$; 814.3 and 837.8 lbs, respectively). The mean days postpartum of cows between Year 1 and 2 differed ($P < 0.01$; 102.4 and 87.6) but was sufficient for the majority of cows to resume estrous cycles in both years. In heifers, the percentage of females cycling was increased in the SB compared to the VB treatment (92.3 and 59.1%, respectively) but did not differ between treatments in the cows

(Figure 2). In heifers, cyclicity differed (Figure 3; $P < 0.05$) by weight category with animals weighing less than 700 lbs less likely to be cycling compared to animals weighing between 700 and 899 lbs or greater than 900 lbs (36.4, 80.6, and 90.0%, respectively). This was expected, as attainment of puberty is influenced by weight with animals with increased growth rates initiating cyclicity at a younger age (Short and Bellows, 1971). It has been hypothesized that inherent differences in growth rates interact with biostimulation, producing variable results in cyclicity status of heifers exposed to bulls (Roberson et al., 1991). In cows, cyclicity differed (Figure 4; $P < 0.05$) between animals with those less than 70 days postpartum at AI being less likely to be cycling when compared to animals between 70 and 100 days postpartum at AI (64.0 and 92.9%, respectively). To maintain a yearly calving interval, females must conceive by 82 d after calving. Increasing cyclicity and the expression of estrus by decreasing the postpartum interval has been one advantage of biostimulation (Rekwot et al., 2001).

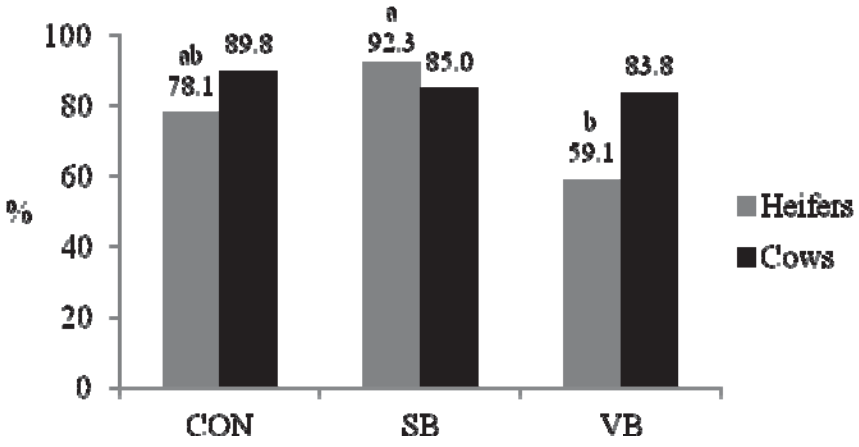


**Figure 2. Percentage of females cycling by treatment. [a,b] Means differ ($P < 0.05$).**

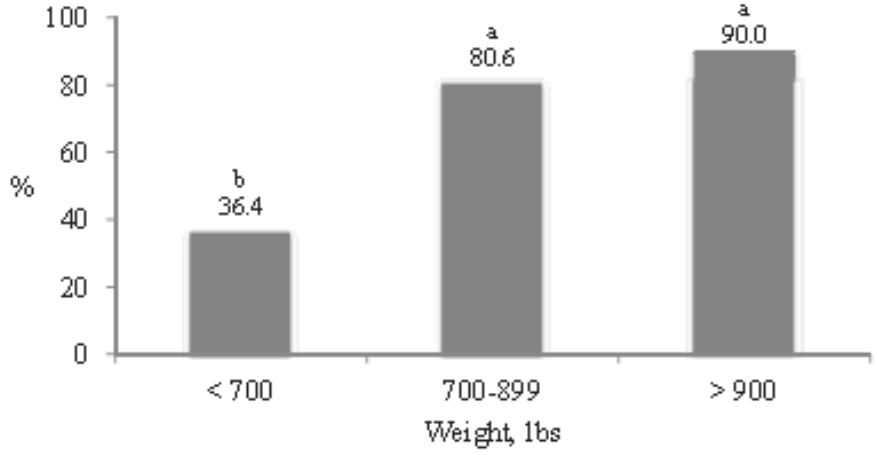


**Figure 3. Cyclicity status of heifers classified by weight. [a,b] Means differ ($P < 0.05$).**

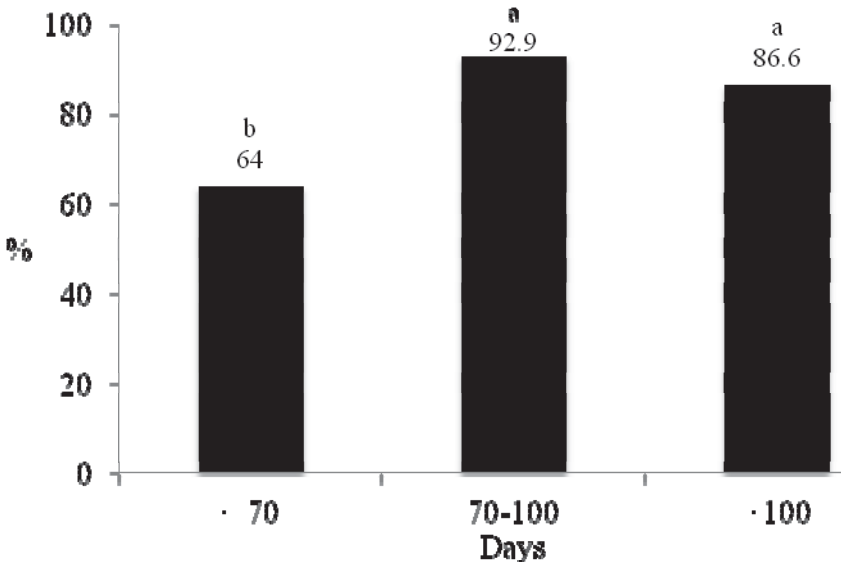


**Figure 4. Cyclicity status of cows classified by days postpartum. [a,b] Means differ (*P* < 0.05).**

*Expression of Estrus*

The percentage of heifers that displayed estrus were increased ($P < 0.05$) in Year 1 (86.8%) compared to Year 2 (66.7%; Figure 5). In contrast, expression of estrus in cows was decreased ($P < 0.001$) in Year 1 (59.1%) compared to Year 2 (84.2%; Figure 5). The effect of year on the expression of estrus demonstrates the complexity of factors interacting to affect this parameter. The percentages of cows that displayed estrus were similar ($P > 0.05$) among treatments (70.5, 77.3, and 72.9% for CON, SB, and VB, respectively; Figure 6) but increased ($P < 0.05$) in heifers exposed to the SB treatment compared to the VB treatment and control (96.3, 73.8, and 69.7%, respectively; Figure 7). The increase in expression of estrus between the time that cyclicity was established (blood collection) and AI can be attributed, in part, to the presence of bulls with exposure increasing occurrence of pubescent estrus (Small et al., 2000). The mechanism by which this occurs has not been established but is hypothesized to involve the interaction of pheromones on the hypothalamo-pituitary-gonadal axis (Small et al., 2000). The factors are complex, and improvements are not always detected in research projects.

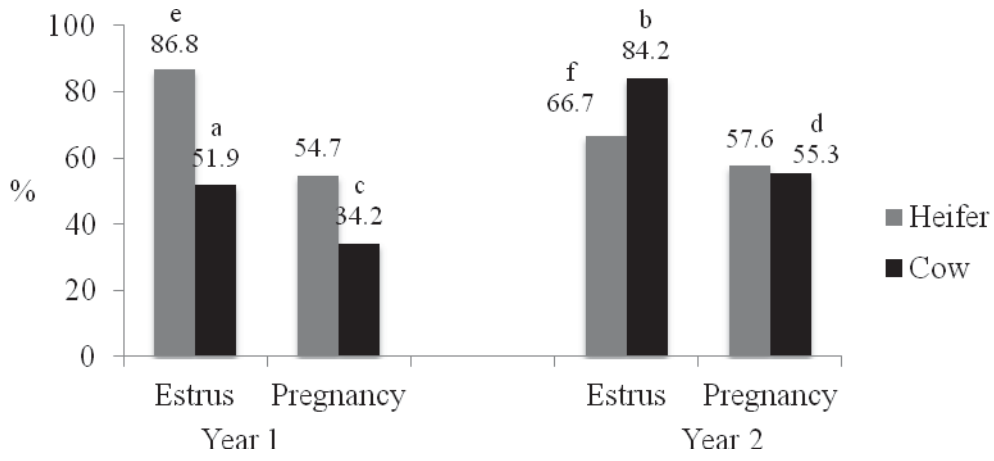


**Figure 5. Expression of estrus and pregnancy rate of heifers and cows by years. [a,b] Means differ (*P* < 0.001); [c,d] Means differ (*P* < 0.01): [e,f] Means differ (*P* < 0.05).**

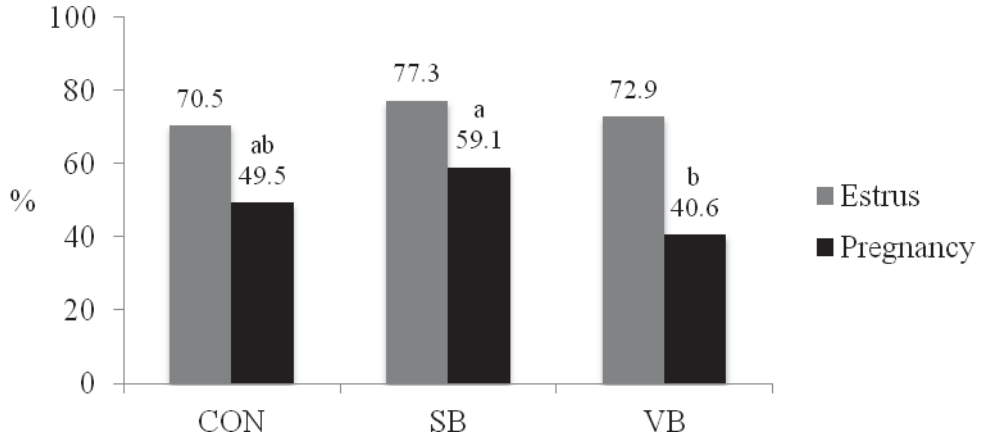


**Figure 6. Expression of estrus and pregnancy rate by treatment. [a,b] Means differ (*P* < 0.05).**

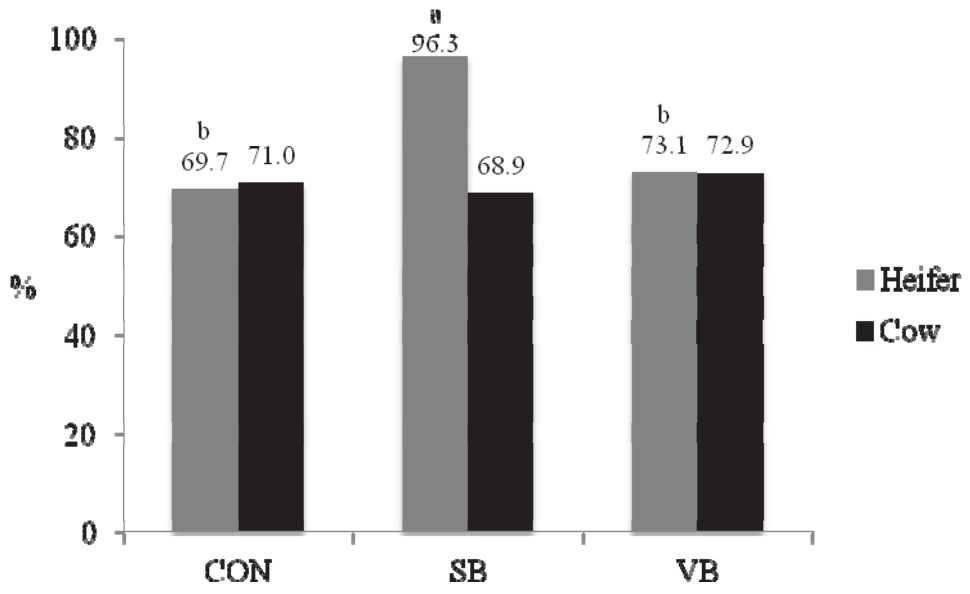


**Figure 7. Expression of estrus of females by treatment. [a,b] Means differ ($P < 0.05$).**

*Pregnancy Rate*

Pregnancy rates were increased ($P < 0.01$) in cows in Year 2 (55.3%) compared to Year 1 (34.2%; Figure 5) and were also increased ($P < 0.05$) in females in the SB treatment group (59.1%) compared to females treated with VB (40.6%) with the control group intermediate (49.5%; Figure 6). Heifer pregnancy rate in the SB treatment group was increased (77.8%; $P < 0.05$) compared to the VB or CON groups (46.2 and 45.5%, respectively). Within the SB treatment, 96.3% of heifers were inseminated after estrus detection compared to 73.1% and 69.7% for the VB and CON groups. The increased expression of estrus translated to an increased pregnancy rate in females exposed to the SB treatment prior to AI. There is a potential that bulls used in this experiment had differences in libido or aggressiveness and these effects could confound results.

## Implications

The objective of this experiment was to determine the biostimulatory effects of bull exposure on the expression of estrus and pregnancy rate to AI in cattle. Results indicate biostimulation prior to AI had an increased effect on the heifers compared to cows, with heifers displaying a greater expression of estrus in both the SB and VB treatment groups. The addition of the deposition of seminal plasma provided by the VB bulls did not produce an improved response over the SB bulls, which supports the concept that the pheromone associated with increased fertility is most likely in the excretory products.

## Acknowledgments

The authors wish to thank the Mississippi Agricultural and Forestry Experiment Station for financial support of this project as well as the employees at the Leveck Animal Research Center, Beef Unit for their assistance in data collection.

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# Alternative Cooling of Dairy Cows by Wetting the Udder

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## Research Summary

Heat stress is a major contributor to production losses in livestock operations, causing severe economic loss. The objective of this study was to determine whether spraying the udder with water, with or without fans blowing air onto the udder, cools the body as effectively as spraying water on the back of the animal with or without fans blowing air on the back. Twelve pregnant, lactating Holstein cows were used over 4 d with 4 applications of each treatment each d. Treatments included wetting of the back with a fan (B+F, n = 24), and without a fan (B+NF, n = 72) blowing air on the back; wetting of the udder, with a fan (U+F, n = 24) or without a fan (U+NF, n = 72) blowing air on the udder. The back or udder of each animal was sprayed with water for 1 min, and in appropriate treatment groups, air from identical fans was blown on the wetted area for the duration of the treatment and measurement time periods. Rectal temperature, respiration rate, and surface skin temperature of the back and udder were collected 10 min after treatment application. Mean Black Globe Heat Index (BGHI) and Temperature Humidity Index for the period were 80.3 ± 0.3 and 81 ± 0.3, respectively. Rectal temperatures and respiration rates were not different ($P > 0.05$) among treatments. Skin surface temperatures of the back were similar among treatments. Interestingly, cows that received B+F tended to have a cooler udder surface temperature (100.6° F; $P \leq 0.06$) compared to all other treatments (101.3, 101.3, and 101.7° F for B+NF, U+NF, and U+F, respectively receiving U+NF, U+F, and B+NF, respectively. In conclusion, efforts to abate heat stress by spraying the udder with water either with or without a fan is as effective as spraying the back with water.

## Introduction

Heat stress is a major inhibitor of production which causes economic loss, particularly in dairy operations. Financial losses due to reduced milk yield caused by heat stress have been estimated to be $897 to $1,507 per animal per year nationally with a reduction in milk yield by 4,568 lb per cow (St. Pierre et al., 2003). Much of the reduction in milk yield is attributed to a decrease in DMI (West, 1994). In addition to the reduction in DMI and milk yield, heat stress has negative impacts on many reproductive parameters (Drost et al., 1999; Wolfenson et al., 2000; Hansen et al., 2001), disease incidences (Giesecke, 1985), and mortality rates (Hahn, 1985). The genetic improvement in milk production of dairy cows leads to increased metabolic activity and subsequently, the generation of more body heat, therefore, efforts to alleviate heat stress in dairy cows are important to the profitability of the dairy industry.

Heat stress is dependent on several factors including: 1) environmental factors such as air temperature, solar load, wind speed, and humidity, 2) animal factors such as rate of metabolism, thermoregulation, and hair-coat color, and 3) social factors such as crowding and proximity. The common

approaches to ameliorate thermal stress have been to provide shade, increase air ventilation to enhance convective cooling, and spray with water (wetting the body) to increase evaporative cooling.

In the mammary gland, milk is produced in the epithelial cells which require significant amounts of nutrients supplied by the blood. Approximately 400 to 500 gallons of blood are required to produce one gallon of milk. In dairy cows, approximately 20% of the blood output from the heart flows into the udder (Knight et al., 1994). Blood flow maintains the temperature of the udder near the core body temperature of the cow (Bitman et al., 1984). This suggests that a large amount of heat could be transferred from the surface of the udder to the environment. Therefore, the objective of this study is to determine whether spraying the udder with water or spraying the udder in combination with blowing air onto the udder cools the body more effectively than spraying water on the back of the animal with or without blowing air on the back.

## Procedures

All procedures on animals were approved prior to the experiment by the Mississippi State University Institutional Animal Care and Use Committee.

*Environmental conditions.* The experiment was conducted in mid-August in east-central Mississippi, which is characterized by a humid subtropical climate with plentiful rainfall throughout the year. The experiment was initiated at approximately 1200 and ended at approximately 1500 each day for 4 consecutive d which had very similar weather conditions. The mean temperatures inside and outside the barn during the 3-h treatment period over the 4 days were 93.9 ± 1.1° F and 98.4 ± 1.6° F, respectively. Mean relative humidity was 55.7 ± 5.5% and mean black globe humidity index was 36.9 ± 1.6 during the treatment period inside the barn. Mean temperature inside the barn during the treatment period for each day was 91.8 ± 0.3°, 93.2 ± 0.6°, 94.8 ± 0.8°, and 95.7 ± 0.7° F.

*Animals and treatments.* Twelve pregnant, first-lactation Holstein cows (31 to 42 mo of age) with a mean milk production of 182.5 lbs (range of 132.3 to 224.4) and mean DIM of 286 (range of 212 to 314) were stratified by DIM and assigned to one of two treatments initially, and then randomly subdivided into two additional treatment groups for the remaining part of the experiment. The experiment consisted of 4 treatments and was carried out over four d with four replications per day. On d 1, six cows were sprayed with water on the udder and six cows were sprayed on their back. On d 2 the treatments were reversed. On d 3, three cows were sprayed on the udder and three cows were sprayed on the back (similar to d 1 and 2) while three cows were sprayed on the udder with the addition of blown air on the sprayed area and three cows were sprayed on the back with the addition of blown air. On d 4, six cows received either the udder or back spray and six cows received the spraying and air blowing.

Animals were housed in a free stall barn and locked in head gates during the experiment. Water was sprayed on cows from a typical garden hose and spray nozzle attachment which sprayed water with a mean temperature of 84.9° F. Animals were sprayed individually for one minute each; water sprayed on the back and tailhead area was allowed to run down the sides of the animal. Water sprayed on the udder was

sprayed to cover the entire udder. When fans were part of the treatment, they were on for the duration of the period.

Rectal temperature, dorsal (back) skin surface temperature, surface temperature of the udder, and respiratory rate were taken daily after cows were restrained and before the heat abatement treatment began to collect initial temperatures and respiration rates for the day. Similar measurements were also collected approximately 10 min after each cow was sprayed with water.

## Results

Rectal temperatures of cows were similar ($P > 0.05$; Figure 1) for all treatments (103.6, 103.3, 103.3, 103.3° F for B+NF, B+F, U+NF, U+F, respectively). While all treatments cooled the cows to a similar rectal temperature, it should be noted that all cows were heat stressed and had an increased temperature compared to normal body temperature.

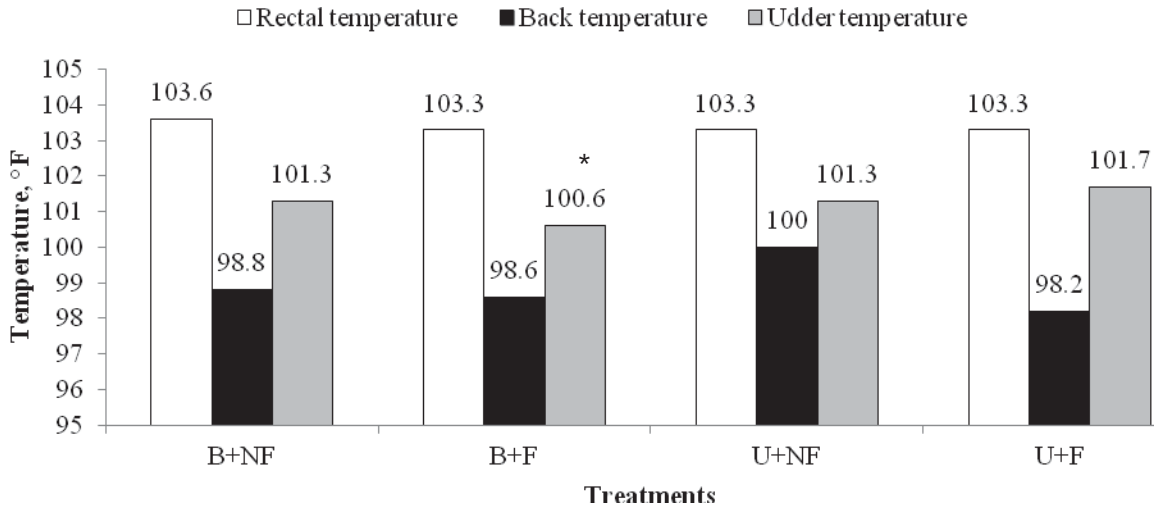


**Figure 1. Rectal temperatures, back skin surface temperatures, and udder skin surface temperatures of cows receiving either wetting of the back with (B+F) or without (B+NF) a fan or wetting of the udder with (U+F) or without (U+NF) a fan blowing air onto the wetted area. *indicates a tendency ($P \leq 0.06$) to be decreased compared to other temperatures in the udder temperature category.**

Respiration rates of cows were also similar ($P > 0.05$) among treatments (110.6, 106.1, 109.0, and 109.0 breaths per minute for B+NF, B+F, U+NF, U+F, respectively). Many of the cows were panting during the treatment period, confirming their heat stressed state.

Temperatures of the skin surface on the back and udder of all cows were collected (Figure 1). The temperatures of the back were similar ($P > 0.05$) among treatments with B+NF, B+F, U+NF, U+F treatments achieving 98.8, 98.6, 100.0, and 98.2° F, respectively. The temperatures of the udder tended ($P \leq 0.06$) to be

significantly different, with the B+F treatment attaining a cooler udder (100.6° F) compared to all other treatments (101.3, 101.3, and 101.7° F for B+NF, U+NF, and U+F, respectively). This is interesting, in that a treatment involving spraying the back actually cooled the udder more than the treatments involving spraying the udder. It should also be noted, that the temperatures of the udders were substantially greater than the temperatures of the back, indicating the increased amount of blood that supports the functions of the udder.

## Implications

Pregnant, lactating Holstein cows experienced severe heat stress conditions during this study. Treatments of wetting the back or udder, with or without fans, led to similar rectal temperatures, respiration rates and skin surface temperatures of the back. The treatment of wetting the back with a fan (B+F) cooled the skin surface of the udder more than the other treatments. In conclusion, efforts to abate heat stress by spraying water on the udder of a cow, with or without a fan blowing air onto the udder was as effective at maintaining core body temperature as spraying water on the back of a cow, with or without a fan.

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# Modifying the Double-Ovsynch Protocol to Include Human Chorionic Gonadotropin to Synchronize Estrus in Dairy Cows and Heifers

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## Research Summary

The objectives of this study were to determine whether conception, ovulation rates, presynchronization rates, or follicle and corpora lutea (CL) characteristics were altered after modifying the Double-Ovsynch (DO) protocol to include human chorionic gonadotropin (hCG) compared to the standard DO protocol. Protocols were conducted in primiparous and multiparous lactating dairy cows (60 to 458 d postpartum at AI; n = 183), or in dairy heifers (13 to16 mo at AI; n = 51). Animals were randomly assigned to one of two treatments: an injection of 100 μg of gonadotropin releasing hormone (GnRH) or 2000 IU of hCG at the initiation of the Pre-Ovsynch (PO) portion of the DO protocol (PO: GnRH/hCG-7d-PGF2α-3d-GnRH). After 7 d following PO, females started the Breeding-Ovsynch (BO) portion of the DO protocol (BO: GnRH-7d-PGF2α-48/56h-GnRH-16h-TAI with sex-sorted semen). Conception rates were similar in females treated with GnRH or hCG in cows (32.2 and 25.0%; P > 0.1) and in heifers (30.8 and 36.0%; P > 0.1). Ovulation rates were determined in cows at the onset of PO and were increased with hCG compared to GnRH (77.2 and 62.2%; P < 0.05). Luteal regression (P4 < 1.0 ng/mL) from the injection of PGF2α of PO did not differ between GnRH- and hCG-treated cows (67.0 and 60.9%; P > 0.1) or heifers (42.3 and 56.0%; P > 0.1). Although more cows ovulated to hCG, a greater proportion of these cows tended to fail to have undergone luteolysis by d 3 post-PGF2α compared to cows that had ovulated to GnRH (29.6 and 16.1%; P = 0.09). In contrast, no heifers failed to have undergone luteolysis. The overall percentage of females which were synchronized to PO did not differ between GnRH- or hCG-treated cows (61.5 and 52.2%; P > 0.1) and heifers (42.3 and 40.0%; P > 0.1). In conclusion, no improvement was achieved by replacing the first injection of GnRH in the DO protocol with hCG.

## Introduction

In the United States, most dairy herds have an estrus detection efficiency of less than 50% (Senger, 1994), resulting in significant economic loses for dairy producers (Senger, 1994). But over the past 15 years, estrus synchronization protocols that allow for timed artificial insemination (TAI) have been developed to combat this problem. Their use greatly reduces the need for estrus detection and increases the overall reproductive efficiency of the herd. The estrus synchronization protocol referred to as Ovsynch, was introduced to the dairy industry in the mid to late 1990s (Pursley et al., 1995). Since then, researchers have developed several modifications to the original Ovsynch protocol.

Conception rates are greatest when the Ovsynch protocol is initiated on d 5 to 12 of the estrous cycle (Vasconcelos et al., 1999). This results in greater rates of ovulation to the first injection of GnRH of Ovsynch and thus increased conception rates (Vasconcelos et al., 1999). A critical

component for successful synchronization of ovulation in dairy cattle involves the inclusion of a presynchronization stage (Bello et al., 2006) that increases the likelihood of ovulation to the first injection of GnRH of Ovsynch, leading to increased conception rates (Vasconcelos et al., 1999).

Souza et al. (2008) introduced the novel idea of combining two Ovsynch protocols to form what is known as Double-Ovsynch. The first Ovsynch is referred to as Pre-Ovsynch (PO) and is used for presynchronizing follicular growth. After the PO, another Ovsynch, the Breeding-Ovsynch (BO), is initiated 7 d later and the cow is inseminated after this Ovsynch. In this study, human chorionic gonadotropin (hCG) was utilized in an attempt to improve the presynchronization stage in both dairy cows and heifers. Human chorionic gonadotropin is a hormone that has similar activity to luteinizing hormone (LH), inducing ovulation by binding to LH receptors on the follicle and producing LH-like effects (Stevenson et al., 2007). Therefore, ovulation of a follicle using hCG is no longer dependent upon the LH surge produced from an injection of GnRH (Kinser et al., 1983). Research has indicated that hCG has an increased capacity to induce ovulation when compared to GnRH (Stevenson et al., 2007; Buttrey et al., 2010). Heifers submitted to the Ovsynch protocol have significantly decreased conception rates as compared to breeding to detected estrus (Pursley et al., 1997). It is thought that this decrease is predominantly caused by the failure of ovulation after the initial injection of GnRH of Ovsynch (Moreira et al., 2000). However, induction of ovulation with hCG in dairy heifers has been reported to be significantly increased compared to GnRH (Dahlen et al., 2008).

Therefore, we hypothesized that replacing the first injection of GnRH in the Double-Ovsynch protocol with hCG would increase the percentage of females that ovulate, thus improving the overall presynchronization rate leading to increased conception rates. The objectives of this study were to determine whether conception, ovulation rates, presynchronization rates, or follicle and CL characteristics were altered after modifying the Double-Ovsynch protocol to include hCG compared to the Double-Ovsynch protocol.

## Procedures

All procedures in this study were approved by the Institutional Animal Care and Use Committee of Mississippi State University. Experiment 1 was conducted in primiparous and multiparous lactating dairy cows (60 to 458 d postpartum at AI; n = 183) during the fall 2009 and 2010 breeding season. Experiment 2 was conducted in dairy heifers (13 to16 mo at AI; n = 51) during the fall 2009 breeding season. Cows and heifers were housed in free-stall barns at the Bearden Dairy Research Center, Mississippi State, MS.

Cows and heifers were randomly assigned to one of two treatments (Figure 1). All females received either an injection of 100 µg (2 mL) of GnRH (Cystorelin; **GnRH**) or 2000 IU (2 mL) of hCG (Chorulon; **hCG**) at the initiation of the PO portion of the Double-Ovsynch protocol (d 0). Seven days later, all females received 25 mg (5 mL) $PGF_{2\alpha}$ (Lutalyse) followed 3 d later (d 10) with an injection of GnRH (PO: *hCG/GnRH*-7 d- $PGF_{2\alpha}$-3 d-GnRH). After 7 d following PO, females started the BO portion of the Double-Ovsynch protocol (BO: GnRH-7d-$PGF_{2\alpha}$-48/56h-GnRH-16h-TAI). All females received TAI with sex-sorted (female) semen.

Ultrasound examinations of ovaries were conducted on d 0, 7, and 10 while only

on d 7 and 10 in heifers (Figure 1). Diameters were recorded of all CL along with all follicles ≥4 mm. Ovulation following the injection of hCG or GnRH on d 0 was confirmed when a newly formed CL was detected on the ovary where a follicle had previously been located. Pregnancy diagnosis was performed on d 32 (cow) or 35 (heifer) post-TAI using ultrasonography and was confirmed by palpation between d 60 and 90.

Blood samples were collected to assess concentration of progesterone (P4) on d 0, 7, 10, and 17 (Figure 1) just prior to the injection of hormones on each day. Females with concentrations of P4 ≥ 1.0 ng/mL were classified as having increased concentrations of P4, while females with P4 < 1.0 ng/mL were classified as having decreased concentrations of P4. Luteal regression from d 7 to 10 was defined as regression of the CL from the injection of $PGF_{2\alpha}$ (d 7 P4 ≥ 1.0 ng/mL and d 10 P4 < 1.0 ng/mL. Synchronization rate to PO was defined as luteal regression from the injection of $PGF_{2\alpha}$ by d 10 and then P4 ≥ 1.0 ng/mL on d 17.

SAS (SAS Inst. Inc., Cary, NC) was used to analyze all data. Cows and heifers were separated for the statistical analysis. Data was considered significant at a *P*-value < 0.05. Tendencies were declared at a *P*-value between 0.05 and 0.10. Standard errors of means are presented.

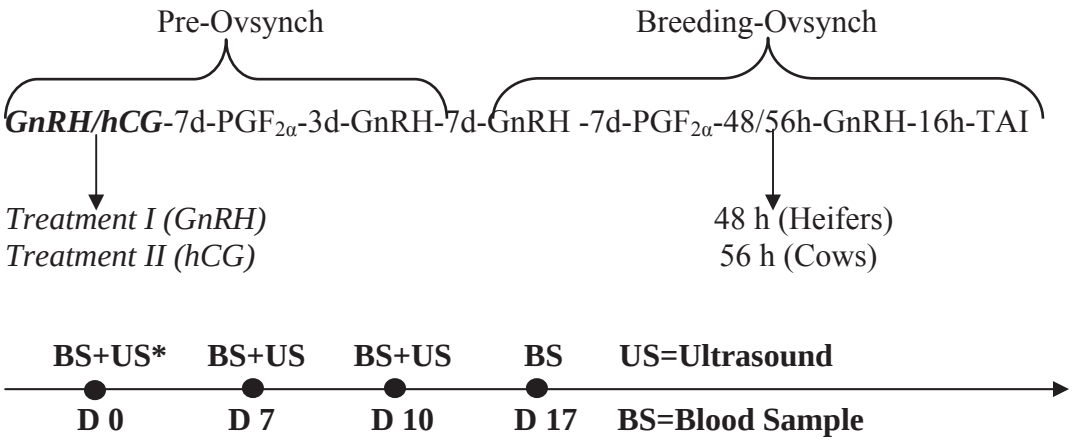


**Figure 1. Schematic of treatment protocols and sampling schedule for cows and heifers during Double-Ovsynch. *Note only cows received ultrasound examination on d 0.**

## Results

### Experiment 1: Dairy Cows

*Ovarian Responses to hCG or GnRH during Pre-Ovsynch.* Ovulation rates at the onset of PO were increased ($P < 0.05$) in cows treated with hCG compared to GnRH (77.2 and 62.2%, respectively). Cows with increased concentrations of P4 (≥ 1 ng/mL) on d 0 had greater ($P = 0.01$) ovulation rates when treated with hCG as compared to GnRH (79.3%, n = 58; and 54.9%, n = 51).

*Measurements at time of $PGF_{2\alpha}$ of Pre-Ovsynch.* The percentage of cows with increased concentrations of P4 on d 7 tended ($P = 0.1$) to be greater in hCG-treated cows than those treated with GnRH (83.7 and 73.6%). Number of CL on d 7 located on both ovaries was greater ($P < 0.001$) in cows treated with hCG than with GnRH (1.9 ± 0.1

and 1.3 ± 0.1, respectively). Diameter of the largest follicle located on either ovary on d 7 tended ($P = 0.08$) to be smaller in cows treated with hCG compared to those treated with GnRH (12.7 ± 0.4 and 13.7 ± 0.4 mm). When compared to just cows that ovulated, cows treated with hCG had a smaller ($P < 0.05$) follicle diameter on d 7 when compared to GnRH (12.4 ± 0.5 and 13.8 ± 0.5 mm).

*Responses to $PGF_{2\alpha}$ and Day 10 Measurements.* Luteal regression by d 10 from the injection of $PGF_{2\alpha}$ did not differ ($P > 0.1$) between cows treated with hCG or GnRH (60.9 and 67.0%; Table 1). The proportion of cows failing to undergo luteal regression by d 10 was greater ($P < 0.05$) in the hCG group than the GnRH group (23.9 and 12.1%). However, of the cows that ovulated, the proportion failing to undergo luteal regression by d 10 tended ($P = 0.09$) to differ in cows treated with hCG than those treated with GnRH (29.6 and 16.1%). The percentage of cows synchronized to PO did not differ ($P > 0.1$) between cows treated with hCG or GnRH (52.2 and 61.5%). Synchronization rate, however, was lesser ($P < 0.05$) in cows that had been treated with hCG on d 0 and ovulated compared to those that ovulated to GnRH (60.6 and 80.4%).

*Evaluation of Breeding-Ovsynch.* Conception rates evaluated on d 32 post-TAI did not differ ($P > 0.1$; Table 1) between cows presynchronized with hCG compared to GnRH (25.0 and 32.2%).

**Table 1. Ovulation, luteal regression, synchronization, and conception rates in all cows and subset of cows that ovulated to hCG or GnRH injection during Pre-Ovsynch**

| | All cows | | | Subset of cows[1] | | |
|---|---|---|---|---|---|---|
| Parameter | GnRH | hCG | *P*-value | GnRH | hCG | *P*-value |
| No. of cows | 91 | 92 | | 56 | 71 | |
| Ovulation to hCG or GnRH (%) | 62.2 | 77.2 | 0.03 | - | - | |
| Luteal regression to $PGF_{2\alpha}$ (%) | 67.0 | 60.9 | 0.39 | 83.9 | 70.4 | 0.09 |
| Failed luteal regression (%) | 12.1 | 23.9 | 0.04 | 16.1 | 29.6 | 0.09 |
| Synchronization rate (%) | 61.5 | 52.2 | 0.19 | 80.4 | 60.6 | 0.02 |
| Conception rate (%) | 32.2 | 25.0 | 0.92 | - | - | |

[1]Analysis of only cows that ovulated to injection of hCG or GnRH on d 0.

**Experiment 2: Dairy Heifers**

*Ovarian Responses to hCG or GnRH during Pre-Ovsynch.* On d 7, no difference ($P = 0.20$) was observed in the proportion of heifers with increased concentrations of P4 between those treated with hCG or GnRH (56.0 and 38.5%; Table 2). Due to a large proportion of heifers having decreased P4 (< 1 ng/mL) on d 0 and 7 of PO, heifers were classified by whether or not they had decreased P4 on both d 0 and 7 of PO (Low-Low). The percentage of heifers classified as Low-Low did not differ ($P > 0.1$) between treatments of hCG and GnRH (20.0 and 26.9%; Table 2) but was affected by age of heifer and likely indicated these heifers had not yet attained puberty. More heifers which were less than the median age of 15 mo at AI tended ($P = 0.07$) to be classified as Low-Low as compared to those that were older (34.6 and 12.0%; Table 4). The number of CL on both ovaries on d 7 was greater ($P < 0.05$) in heifers treated with hCG compared to GnRH (1.5 ± 0.2 and 0.9 ± 0.2; Table 2). Heifers treated with hCG had a greater ($P = 0.05$) mean follicle diameter than those treated with GnRH (12.8 ± 0.7 and 10.9 ± 0.8 mm) on d 7 of

PO. An interaction of treatment by P4 status (< 1 or ≥ 1 ng/mL) tended ($P = 0.08$) to affect follicle diameter on d 7 (Figure 2).

*Responses to $PGF_{2\alpha}$ and Day 10 Measurements.* Luteal regression from the injection of $PGF_{2\alpha}$ was similar ($P > 0.1$) between treatments (56.0% for GnRH and 38.5% for hCG; Table 3). Heifers synchronized to PO did not differ ($P > 0.1$) between treatments of hCG and GnRH (40.0 and 42.3%) but was affected ($P < 0.01$) by age of heifer (< 15 mo, 23.1%; and ≥ 15 mo, 60.0%).

*Evaluation of Breeding-Ovsynch.* Conception rates did not differ ($P > 0.1$) between heifers treated with hCG compared to GnRH (36.0 and 30.8%; Table 3). However, conception rates were greater ($P < 0.05$) in heifers that were older as compared to those that were younger (48.0 and 19.2%; Table 4).

**Table 2. Ovarian measurements taken in heifers on d 7 of Pre-Ovsynch**

| | Treatments | | |
|---|---|---|---|
| Parameter | GnRH | hCG | *P*-value |
| No. of heifers[1] | 26 | 25 | |
| $PGF_{2\alpha}$ injection (d 7) | | | |
| Increased progesterone[2], (%) | 38.5 | 56.0 | 0.20 |
| Low-Low[3] (%) | 26.9 | 20.0 | 0.52 |
| No. of corpora lutea (CL), (no.) | 0.9 ± 0.2 (21) | 1.5 ± 0.2 (23) | 0.03 |
| Follicle diameter[4], mm (no.) | 10.9 ± 0.8 (21) | 12.8 ± 0.7 (23) | 0.05 |

[1]Ovarian scans missing on 7 heifers (GnRH: n = 5; hCG: n = 2).
[2]Percentage of heifers with plasma progesterone ≥ 1 ng/mL.
[3]Percentage of heifers with plasma progesterone < 1 ng/mL on d 0 and 7.
[4] Diameter of largest follicle located on either ovary.

**Table 3. Luteal regression, synchronization, and conception rates in heifers**

| | Treatments | | |
|---|---|---|---|
| Parameter | GnRH | hCG | *P*-value |
| No. of heifers | 26 | 25 | |
| Luteal regression to $PGF_{2\alpha}$ (%) | 38.5 | 56.0 | 0.20 |
| Synchronization rate[1] (%) | 42.3 | 40.0 | 0.88 |
| Conception rate[2] (%) | 30.8 | 36.0 | 0.65 |

[1]Percentage of heifers synchronized to Pre-Ovsynch.
[2]Assessed at d 35 post-TAI.

**Table 4. Effect of age of heifer on concentrations of progesterone, and synchronization and conception rates**

| | Age of heifer at AI | | |
|---|---|---|---|
| Parameter | < 15 mo | ≥ 15 mo | *P*-value |
| No. of heifers | 26 | 25 | |
| Day 7 | | | |
| Low-Low[1] (%) | 34.6 | 12.0 | 0.07 |
| Day 17 | | | |
| Synchronization rate[2] (%) | 23.1 | 60.0 | 0.01 |
| Conception rate (%) | 19.2 | 48.0 | 0.04 |

[1]Percentage of heifers with plasma progesterone < 1 ng/mL on both d 0 and 7.
[2]Percentage of heifers synchronized to Pre-Ovsynch.

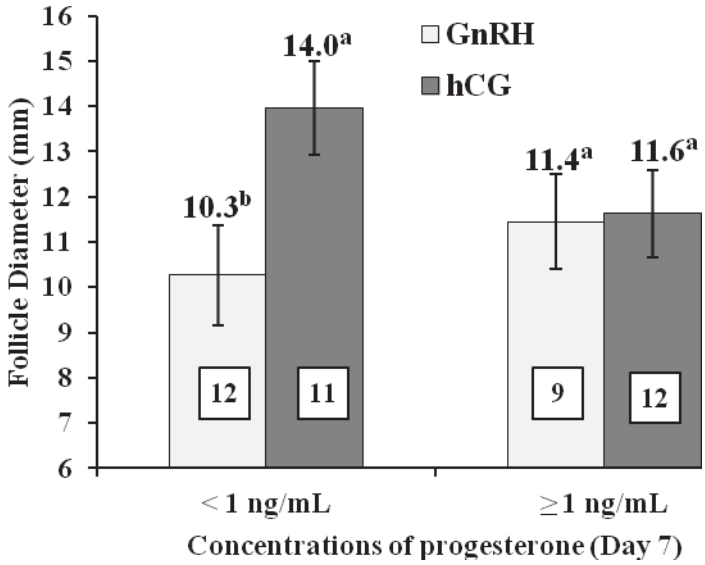


**Figure 2. Diameter of largest follicle located on either ovary on d 7 of Pre-Ovsynch in heifers (LSMeans ± SEM; Experiment 2). Numbers of heifers are presented within each bar. [a,b]LSMeans within a category (< 1 or ≥ 1 ng/mL P4 on d7 of PO) with a different superscript differ (*P* < 0.05).**

## Implications

The results of the present study indicate that hCG had an increased capacity to induce ovulation in dairy cows as compared to those treated with GnRH. Interestingly, a greater proportion of cows ovulating a follicle to hCG at the onset of PO tended to fail to undergo luteal regression by d 3 post-PGF2α administration as compared to those ovulating a follicle to GnRH. This then resulted in no difference in synchronization and conception rates. In Experiment 2, many of the reproductive parameters measured in dairy heifers were affected by age and was likely due to several heifers being pre-pubertal before the onset of PO. In conclusion, no advantage was identified in replacing the first injection of GnRH of PO with hCG for both cows and heifers on ovarian characteristics and responses, as well as subsequent fertility. The importance of age of heifers and

attainment of puberty before AI was emphasized.

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# Evaluation of a Cotton By-Product as a Supplemental Feed for Stocker Cattle in South Mississippi

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## Research Summary

A cotton ginning by-product (CPM) was evaluated as a supplemental feedstuff for cattle (n = 52) grazing dormant summer pastures during a 70 d period in 2010. Bales of CPM are a mixture of cotton gin, cotton mote, added protein, molasses and a complete mineral package, and are designed to be a self-fed complete feed for pasture cattle. In this study, CPM was compared to a limit fed diet (DIET) of soybean hull pellets, dried distiller's grains with solubles and a mineral package in a randomized complete design using pasture as the experimental unit. There were four pastures per treatment and each pasture was approximately 8.1 acres in area and consisted of dormant summer grasses (mix of bahiagrass, bermudagrass, and crabgrass) and were stocked with either 6 or 7 head of crossbred cattle (*Bos Taurus* x *Bos Indicus*). All pastures were clipped to a uniform height prior to initiation of the study to equate forage mass. Treatments were CPM fed ad libitum and SBH/DDGS limit fed at the rate of 1.5% of BW and was formulated to be similar in nutrient profile to the CPM bale, and were randomly assigned to pasture. Cattle were stratified by BW and assigned to pasture. Cattle fed CPM had greater feed intake compared to cattle limit fed SBH/DDGS (14.31lb vs. 10.34 lb, respectively, $P < 0.10$). Nonetheless, cattle fed DIET had greater ADG ($P < 0.05$) compared to cattle fed CPM (1.68 lb vs 1.32 lb, respectively). Additionally, cattle fed DIET had more efficient supplement only feed conversion ($P < 0.05$). Nontheless, due to by product nature of CPM (primarily gin-trash) it was less expensive and thereby resulted in a similar cost of gain ($P > 0.10$) compared to DIET. Results of the study indicate that limit feeding a mixed ration resulted in greater daily gain and efficiency, compared to the CPM bale, however, did not result in greater cost of gain, when supplemented to stocker cattle in the fall months.

## Introduction

Stocker cattle production favors the utilization of forage by the animal to achieve adequate rates of gain at an economical advantage. However, during periods of low forage production and quality many producers often turn to supplements to meet nutrient demands for adequate rates of gain (Coulibaly et al, 1996). Often by-products are used as supplements due to their availability (Davis et al., 2006), and economic attractiveness. One by-product readily available in the South is residue from the cotton-ginning process (gin trash and mote). Typically, this feed is high in fiber with the majority of its use coming from its addition as a roughage source for feedlot type diets (Hill et al., 1999a). While gin trash is high in fiber, it can be low in energy, and alone is not adequate for higher rates of gain required by stocker operations (Hill et al., 1999b). Grain by-products namely dried distiller's grains with solubles (DDGS) have been evaluated extensively as a supplement for growing cattle (Islas and Soto-Navarro, 2010; Greenquist et al., 2006). The nutrient properties of DDGS (high digestible fiber, high energy, and adequate protein (Islas and Soto-Navarro, 2010) would make it an ideal

complement to a lower quality feedstuff. Additionally, the use of DDGS mixed with other by-product feeds has been evaluated (Davis et al., 2006), however data are lacking with regards to its use in gin-trash based diets.

Recently, a commercially available product has been introduced. The CPM bale is a proprietary formula of gin trash, DDGS, a liquid vitamin/supplement, and propionic acid mixed and compacted into 500-lb bales. This feed is designed to be fed free choice as a hay and protein replacement for beef cattle. Due to its novel technology, few data exist regarding its use as a potential supplemental feed for stocker cattle. Thus, a study was established to examine the use of CPM bale as a feed for stocker cattle.

## Procedures

*Treatments*. The gin-trash bales (CPM) were shipped 496 miles to the White Sand Branch Exp. Station from Eastman, GA, several weeks prior to the initiation of the study. This allowed for chemical analysis of the nutrient content. Based upon the nutrient analysis of the bale, an isonitrogenous diet (DIET) was formulated using soybean hull pellets (73% DM basis), dried distillers grains with solubles (25% DM basis) and a mineral package (2% DM basis). Treatments were then randomly assigned to pasture, with pasture being the experimental unit. By design, the CPM bale was fed at one time, and was replaced when it was deemed necessary by personnel of White Sand Branch Beef Unit, the DIET was limit fed (1.5% of BW) daily. To facilitate collection of orts, the bale was placed into a large feed trough. Weekly grab samples of both feeds were obtained, and dried in a forced air oven at 100$^{o}$C for 24 to determine DM content. Weekly DM samples were composited and submitted to a commercial lab for nutrient analysis. Nutrient analysis of both diets is presented in Table 1.

**Table 1. Nutrient composition of treatments**

| Item | CPM Bale | DIET[a] |
|---|---|---|
| DM, % | 86.15 | 88.58 |
| CP, % | 16.60 | 16.81 |
| TDN, % | 63.00 | 65.00 |
| NEm (Mcal/lb) | 0.64 | 0.65 |
| NEg (Mcal/lb) | 0.36 | 0.41 |

[a]Diet = 73% Soybean hulls, 25% DDGS and 2% mineral package (DM basis).

Each pasture was approximately 8.1 ac in area, and consisted of a mix of Bahiagrass (*Paspalum notatum* ) and Bermudagrass (*Cynodon dactylon*). Prior to treatment placement each paddock was clipped to uniform height to equate forage mass. Due to the season (Autumn), and lack of rainfall (Figure 1), no further pasture growth occurred for the duration of the study.

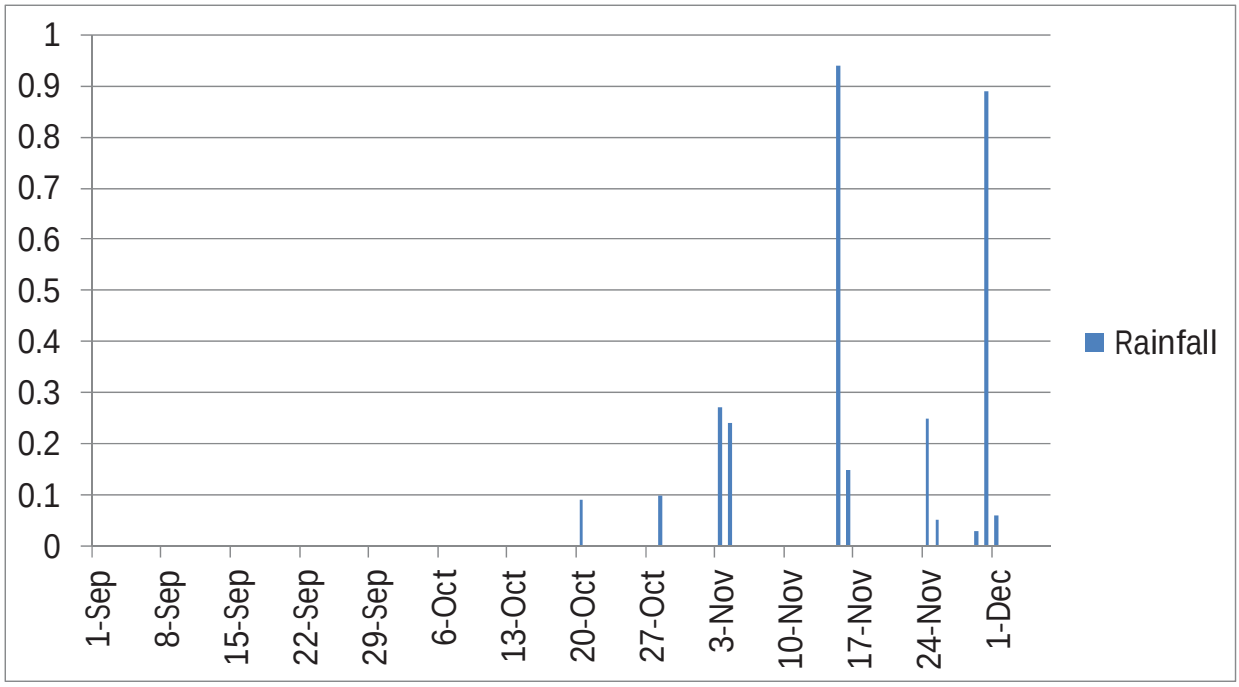


**Figure 1. Rainfall data from the USDA NOAA in Poplarville, MS, reported in inches during the period of the study**

*Cattle.* Fifty-two crossbred (*Bos taurus* x *Bos indicus*) beef steers were used for the study. Steers had been held on a limit fed growing ration and free choice hay prior to utilization for the study. On October 4, 2010, steers were individually weighed for a sort weight. Steers were then stratified by BW and assigned to pastures. Steers were again weighed on October 5, 2010, moved to pastures, and the trial began. Steers were again individually weighed 41 d later, and the planned midpoint of the study. The study concluded at d 62 on December 5, 2010.

*Statistical Analysis.* Data were analyzed as a randomized complete block using PROC GLM of SAS. Fixed effects included treatment, and pasture was used as the experimental unit. Significance was declared at $P < 0.10$.

## Results

Performance data are presented in Table 2. There were no differences in initial BW, however, cattle consuming the DIET had heavier BW ($P = 0.009$) at the end of the 62 d growing period. Cattle consuming DIET had greater ADG ($P < 0.02$) at both the 41-d weigh period and the overall study. Additionally, the overall DMI did not differ the first 41 d of the study, however, it should be noted for the overall study DMI was greater for cattle consuming CPM free choice than for the DIET treatment. The increase in consumption occurred after the 41-d weigh period, when the ambient temperature began to decrease. Webster et al, (1970), demonstrated that intake of cattle exposed to a colder environment increased. Moreover, since cattle fed DIET were limit fed, the difference became more pronounced, throughout the study. It is unclear why the greater intake did not result in improved performance. Using actual

performance data, a back calculation of diet NEm and NEg was conducted using equations in NRC (2000), resulted in a greater value of NEm and NEg for the DIET group, compared to what was reported from the chemical analysis. It should be noted that this discrepancy between reported and calculated energy values is a paradox that is common with the utilization of DDGS (Klopfenstein et al., 2008) in diets. Additionally, Loerch and Fluharty (1998) also demonstrated that as the level of feed was restricted in feedlot, the less accurate the NE equations became, it is unclear if this relationship exists with pasture cattle limit fed a supplement.

**Table 2. Performance of beef steers fed different supplemental feeds during autumn months**

| Item | CPM Bale[a] | DIET[b] | SE | *P*-value |
|---|---|---|---|---|
| Initial BW, lb | 708.8 | 708.2 | 15.00 | - |
| Final BW, lb | 811.6 | 759.5 | 14.45 | 0.009 |
| ADG, lb/d | | | | |
| Day 0-41 | 3.19 | 2.17 | 0.15 | 0.001 |
| Day 0-62 | 1.67 | 1.33 | 0.11 | 0.02 |
| Supplement DMI, lb/d | | | | |
| Day 0-41 | 11.14 | 10.35 | 0.65 | 0.39 |
| Day 0-62 | 14.40 | 10.34 | 1.03 | 0.03 |
| Feed:Gain[c] | | | | |
| Day 0-41 | 5.12 | 3.25 | 0.20 | 0.001 |
| Day 0-62 | 11.18 | 6.30 | 1.32 | 0.04 |
| Cost of Gain[d] | | | | |
| Day 0-62 | $0.89 | $0.83 | 0.12 | 0.65 |

[a]CPM = CPM complete feed, 500 lb bale
[b]DIET = 73% Soybean hulls, 25% DDGS and 2% mineral package (DM basis)
[c]Supplement only feed:gain
[d]Cost of gain based on $158/ton CPM and $260/ton DIET.

The increase in ADG with a lower DMI resulted in a more efficient rate of gain for cattle fed DIET. Similarly Loerch and Fluharty (1998) demonstrated that limit feeding cattle resulted in more efficient performance. Additionally, Horn et al, (1995) demonstrated that limit feeding a supplemental soybean hull diet to cattle grazing wheat pasture resulted in an improvement in feed conversion. While DIET resulted in improved feed conversion, it should be noted that fluctuations in commodity prices at that time of year (Autumn/Winter, 2010) resulted in a higher cost per ton of the DIET than CPM, which led to no differences in cost of gain ($P$ = 0.65).

## Implications

The utilization of CPM for a supplemental feed for stocker cattle may be of some benefit to some producers since the bales can be fed free choice and do not require daily feeding. However, based upon the results of the study conducted, CPM resulted in greater intake, decreased performance and less efficient gain when compared to a mixed diet of soybean hulls and DDGS. Nonetheless, due to market conditions, there was no difference in cost of gain between feeds. In some scenarios, the use of CPM may be more beneficial; nonetheless, further strategies involving the use of CPM under different environmental conditions warrant further investigation.

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# Effects of Calf Disposition, Morbidity, and Finishing Net Return Quartile on Feedlot Performance, Carcass Traits, and Finishing Economics

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## Research Summary

Records of steers (n = 1,987) and heifers (n = 764) consigned to the Mississippi Farm to Feedlot Program from 2005 to 2011 and shipped to Iowa feedlots as part of the Tri-County Steer Carcass Futurity were used to evaluate the effects of calf disposition, morbidity, and finishing net return quartile on feedlot performance, carcass traits, and finishing economics. As disposition score increased, indicating less desirable temperaments, feedlot ADG, final BW, backfat thickness, calculated YG, final live value, and net return from finishing decreased ($P < 0.05$). Calves that were medically treated had reduced ($P < 0.05$) feedlot ADG, HCW, backfat thickness, calculated YG, final live value, and net return from finishing than their healthy counterparts. Finally, calves with less morbidity, treatment cost, backfat thickness, and calculated YG and greater feedlot entry weight, feedlot ADG, final BW, HCW, dressing percent, percent retail product, LM area, marbling score, and USDA QG had greater ($P < 0.05$) finishing net return. These results indicate the importance of selection for docile disposition and implementation of effective health management protocols. Characteristics of fed cattle and their carcasses that result in greater finishing net return include less-morbid, faster-growing cattle that result in heavier carcass with more desirable USDA QG and calculated YG.

## Introduction

It is documented that poorer calf temperament and increased morbidity decrease ADG, marbling score, QG, YG, and finishing net return (Gadberry and Troxel, 2006; Vann et al., 2008; Reinhardt et al., 2009), although the findings of Waggoner et al. (2007) dispute the marbling score and YG findings in regards to morbidity effect. Characteristics of more profitable steers in various finishing and harvest systems have also been described (Gadberry and Troxel, 2006). The Mississippi Farm to Feedlot Program dataset provides a unique opportunity to research these relationships among animals from multiple sources of origin and management programs over an extended period of time. Therefore, the objectives of the present study were to assess the 1) impact of calf temperament on feedlot performance, carcass traits, and finishing economics; 2) effect of morbidity on feedlot performance, carcass traits, and finishing economics; and 3) characteristics of calves and their carcasses within finishing net return quartiles.

## Procedures

Records of steers (n = 1,987) and heifers (n = 764) consigned to the Mississippi Farm to Feedlot Program from 2005 to 2011 and shipped to Iowa feedlots were used in this analysis. The cattle represented 29 unique farms of origin, 26 feedlot delivery dates, and 30 feeding pens.

Cattle from Mississippi operations were shipped to feedlots in Southwest Iowa participating in the Tri-County Steer Carcass Futurity (**TCSCF**) beginning in 2005, with the most recent harvest for this dataset occurring in May 2011. Seven different TCSCF feedlots were utilized during this time period. Calf shipments to these feedlots occurred during 8 different months, with the majority (61.6%) of calves shipped during the month of June. Late summer, autumn, early winter, and early spring were other key periods of calf shipment activity.

An on-farm preconditioning period was strongly suggested prior to shipment to the feedlot, but the details of the preconditioning program were left to the owner's discretion. Producers were encouraged to select calves that were representative of their breeding and management programs for enrollment in the Mississippi Farm to Feedlot Program. They were also encouraged to provide information on calf age (individual age or group birth dates), sire and dam identification, and sire and dam breed composition. Appropriate forms were provided to consignors interested in pursuing age verification premiums.

On the day of shipment to the feedlot, calves were weighed and pooled into truckload, 49,000-lb lots at producer farms or Mississippi Agricultural and Forestry Experiment Station sites. Truckload lots and feeding pens represented both single and multiple consignors and both single and mixed calf sex groups (17 steer pens, 5 heifer pens, and 8 mixed sex pens). All calves were weighed within 7 days of arrival, after approximately 35 days on feed (warm-up period), at re-implant time, and within 5 days of harvest. Final body weight was adjusted using overall average daily gain values to the date of harvest. All calves were vaccinated upon arrival, implanted, and offered a starting feedlot diet. A common dietary energy level (approximately 1.41 Mcal of $NE_g$/kg of DM feed) was used at all 7 feedlots. The implant protocol across all feeding groups typically consisted of an estrogenic implant upon arrival, followed by a combination estrogenic/androgenic implant, and then another combination estrogenic/androgenic terminal implant before harvest.

A disposition score (Beef Improvement Federation 6-Point Scoring System: 1 = docile and 6 = very aggressive) was assigned at on test weighing, re-implant time, and pre-harvest. These disposition scores were averaged to calculate a mean disposition score. The mean disposition score was used (rounded to the nearest integer) to classify calves into 3 groups for analysis: 1 and 2 = **docile**, 3 and 4 = **nervous**, and 5 and 6 = **aggressive**.

Cattle were observed daily for morbidity by feedlot personnel. Animals were removed from home pens when showing clinical signs of respiratory disease, including lethargy, ocular or nasal discharge, or emaciation. Of the cattle removed for clinical signs, those exhibiting rectal temperatures greater than 103.5°F received medical treatment consisting of antimicrobial therapy. Data for mortalities were excluded from all statistical analyses. Morbidity was defined as whether or not calves received medical treatment during the finishing period, and morbidity rates were calculated accordingly. Number of days steers were medically treated was categorized into 3 distinct groups: 0 (**healthy**), 1 (**ONE**), and ≥ 2 (**TWO+**) days. Orthogonal contrasts were used to compare differences between healthy and morbid calves (ONE and TWO+ categories; **treated**), and to evaluate differences among

calves treated once vs. those treated more than once (ONE vs TWO+).

Feed to gain ratio was calculated for each animal using pen level feed disappearance and individual animal body weight gain from the beginning to end of the feeding period and carcass yield grade. The yield grade measurement was used to quantify the percent bone, lean, and fat in the carcass. Using this information, the Cattle Value Discovery System was used to prorate total pen feed consumption across the individual animals based on the amount and composition of gain, lean versus fat. Thus, the resulting feed to gain variable incorporated average daily gain (Perry and Fox, 1997).

Calves were visually evaluated for degree of finish by TCSCF personnel 60 to 80 days after administration of the terminal implant. Animals were determined to be adequately finished when they were visually assessed to have 0.4 to 0.5 inches of backfat. They were then sorted and the cattle determined adequately finished shipped to a commercial abattoir, Tyson Fresh Meats (formerly IBP), Denison, IA. Calves not shipped with the first marketing group were shipped to the abattoir when determined to be adequately finished, typically 28 or more days after the first marketing group.

Upon harvest, detailed carcass data were collected by TCSCF personnel and USDA Graders. Trained TCSCF personnel measured hot carcass weight; back fat thickness; and ribeye area; and estimated kidney, pelvic, and heart fat in the harvest plant on each beef carcass ahead of the grading station. Yield grade was calculated from these carcass measurements. In addition, a USDA grader determined the marbling score, quality grade, and yield grade and based on visual appraisal.

The beginning calf dollar value at feedlot entry was based on cattle weights and the Mississippi USDA weekly feeder cattle summary for the week of shipment to the feedlot. Total cost per animal for finishing was the sum of each calf's feeder animal cost (beginning dollar value at feedlot entry), feed cost, yardage charge, identification tags, animal medical treatments, vaccines, parasite control, implants, trucking to the feedlot, trucking to the abattoir, data collection fee, insurance, and interest. Feed cost was based on feed prices, total body weight gain, and feed to gain ratio. Cattle were marketed on grids paying premiums and discounts based on quality grade and yield grade and discounts on outside of weight range carcasses. Total revenue consisted of sale of each carcass on the value-based grids being utilized by the abattoir at the time of harvest. Net return per animal was the difference between total revenue and total costs. Calves were categorized into four quartiles for finishing net return within feeding group in order from greatest to least finishing net return: **top**, **second**, **third**, and **bottom** 25%.

Data were analyzed with the MIXED (for continuous dependent variables) and GLIMMIX (for categorical and percentage-dependent variables) procedures in SAS (SAS Inst. Inc., Cary, NC). For the disposition analysis, main effects included disposition group, calf sex, and their interaction. For the morbidity analysis, main effects included morbidity group, calf sex, and their interaction. For the finishing net return quartile analysis, main effects included finishing net return quartile, calf sex, and their interaction. To account for differences across feeding groups, feeding group was included as a random variable in all models. Initial BW was included as a covariate in the analysis for all variables, except when analyzing for the effects of

initial BW, initial BW per day of age, and age at feedlot entry. Final BW, HCW, marbling score, and USDA QG were corrected for fatness by including calculated YG as a covariate in these models because marketing endpoint for all cattle was determined subjectively via visual appraisal of individual animals for degree of fatness. Least squares means were separated at $P < 0.05$.

## Results

The effect of calf disposition of Mississippi Farm to Feedlot Program calves shipped to Iowa feedlots from 2005 to 2011 on feedlot performance, carcass traits, and finishing economics is presented in Table 1. No differences ($P > 0.05$) in morbidity rate, treatment cost, days on feed, marbling score, USDA QG, HCW, or KPH by disposition category were found. However, Vann et al. (2008) observed that treatment cost and days treated increased with poorer temperament as assessed using chute scores and exit velocities. In the present study, docile calves had the greatest ($P < 0.05$) feedlot ADG and final BW (3.46 lb/d and 1,258 lb, respectively), nervous calves had intermediate ($P < 0.05$) feedlot ADG and final BW (3.30 lb/d and 1,245 lb, respectively), and aggressive calves had the least ($P < 0.05$) feedlot ADG and final BW (3.09 lb/d and 1,213 lb, respectively). Reinhardt et al. (2009) also found that as disposition score increased, feedlot ADG and final BW decreased. Similarly, Vann et al. (2008) observed that as exit velocity increased, final BW and feedlot ADG decreased. In the present trial, dressing percent, retail product, and LM area per unit HCW were least ($P < 0.05$) for the docile calves in the present trial. In addition, docile calves had smaller ($P < 0.05$) LM area than nervous calves. This is in contrast to the finding of Reinhardt et al. (2009), who determined that LM area decreased as disposition score increased. Also, in the present study, backfat thickness, calculated YG, and final live value were greatest ($P < 0.05$) for the docile calves. Reinhardt et al. (2009) likewise found that backfat thickness and calculated YG decreased as disposition score increased. Net return from finishing was least ($P < 0.05$) for the aggressive calves in the present study. This compares to the findings of Vann et al. (2008), who found that net return tended to decrease as exit velocity increased.

**Table 1. Effect of calf disposition on feedlot performance, carcass traits, and finishing economics, Mississippi Farm to Feedlot Program 2005 to 2011**

| | Disposition category (D)[1] | | | | *P*-value | | |
|---|---|---|---|---|---|---|---|
| Item | Docile | Nervous | Aggressive | SEM | D | Sex | D × sex |
| Morbidity rate, % | 12.0 | 12.6 | 17.8 | 3.53 | 0.57 | 0.08 | 0.20 |
| Treatment cost, $/calf | 4.20 | 4.31 | 8.50 | 1.457 | 0.21 | 0.01 | 0.10 |
| Initial BW, lb | 739[a] | 725[b] | 716[ab] | 18.0 | <0.01 | 0.45 | 0.06 |
| Feedlot ADG, lb/d | 3.46[a] | 3.30[b] | 3.09[c] | 0.10 | <0.01 | <0.01 | 0.18 |
| Final BW, lb | 1,258[a] | 1,245[b] | 1,213[c] | 13.8 | <0.01 | <0.01 | .015 |
| Days on feed, d | 154 | 155 | 154 | 3.9 | 0.14 | 0.90 | 0.61 |
| Marbling score[2] | 512 | 507 | 498 | 6.9 | 0.09 | 0.02 | 0.99 |
| USDA QG[3] | 18.4 | 18.3 | 18.3 | 0.13 | 0.07 | 0.10 | 0.56 |
| HCW, lb | 773 | 770 | 778 | 8.7 | 0.48 | <0.01 | 0.75 |
| Dressing percent, % | 61.4[b] | 61.7[a] | 62.1[a] | 0.14 | <0.01 | 0.28 | 0.13 |
| Retail product, % | 63.8[b] | 64.3[a] | 64.8[a] | 0.23 | <0.01 | 0.34 | 0.50 |
| Backfat thickness, in | 0.46[a] | 0.43[b] | 0.41[b] | 0.015 | <0.01 | 0.27 | 0.66 |
| KPH, % | 2.2 | 2.1 | 2.1 | 0.06 | 0.16 | 0.28 | 0.83 |
| LM area, $in^2$ | 12.7[b] | 12.9[a] | 13.1[ab] | 0.14 | 0.02 | 0.03 | 0.59 |
| LM area per unit HCW, $in^2$/cwt | 1.66[b] | 1.68[a] | 1.71[a] | 0.018 | <0.01 | 0.21 | 0.61 |
| Calculated YG | 2.94[a] | 2.80[b] | 2.68[b] | 0.063 | <0.01 | 0.49 | 0.51 |
| Final live value, $/calf | 1,106.58[a] | 1,091.39[b] | 1,065.45[b] | 19.615 | <0.01 | 0.51 | 0.09 |
| Net return from finishing, $/calf | 38.70[a] | 31.10[a] | -40.57[b] | 15.051 | <0.01 | <0.01 | 0.14 |

[a,b,c]Means with different superscripts within row differ ($P < 0.05$).

[1]A disposition score (Beef Improvement Federation 6-Point Scoring System: 1 = docile and 6 = very aggressive) was assigned at on test weighing, re-implant time, and pre-harvest. Disposition scores were averaged to calculate a mean disposition score and then rounded to the nearest integer to classify calves into 3 groups for analysis: 1 and 2 = docile, 3 and 4 = nervous, and 5 and 6 = aggressive.

[2]Marbling score: Slight = 400-499; Small = 500-599.

[3]USDA QG: $Select^-$ = 17; $Select^+$ = 18; $Choice^-$ = 19.

Table 2 presents the effect of calf morbidity on feedlot performance, carcass traits, and finishing economics of the calves in this study. Treatment cost was greater ($P < 0.05$) in treated than healthy calves as well as greater ($P < 0.05$) in TWO+ than ONE calves. Mean disposition score, retail product, and LM area per unit HCW were less ($P < 0.05$) for healthy than treated calves but not different ($P > 0.05$) between ONE and TWO+ calves. Additionally, initial BW, feedlot ADG, final BW, HCW, backfat thickness, calculated YG, and final live value were greater ($P < 0.05$) for healthy than treated calves but not different ($P > 0.05$) between ONE and TWO+ calves.

This is comparable to other studies in which lighter weight calves at feedlot entry were more likely to receive medical treatment during finishing (Gadberry and Troxel, 2006; Reinhardt et al., 2009). Other researchers demonstrated advantages in ADG (Waggoner et al., 2007; Reinhardt et al., 2009), final BW (Gadberry and Troxel, 2006; Reinhardt et al., 2009), and HCW (Gadberry and Troxel, 2006; Reinhardt et al., 2009) for healthy over treated groups. Net return from finishing was less ($P < 0.05$) in treated than healthy calves as well as less ($P < 0.05$) in TWO+ than ONE calves. Calf morbidity did not affect ($P > 0.05$) days on feed, marbling score, USDA QG, dressing percent, KPH, or LM area. Reinhardt et al. (2009) saw a linear decrease of marbling score and USDA QG as the number of treatments for respiratory disease increased from 0 to 1 to ≥ 2. Roeber et al. (2001)

documented that steers receiving 1 medical treatment were intermediate in marbling score as compared to contemporaries received either no or 2 or more medical treatments. Furthermore, Waggoner et al. (2007) and Garcia et al. (2010) found no differences in marbling score among various morbidity classifications.

**Table 2. Effect of calf morbidity on feedlot performance, carcass traits, and finishing economics, Mississippi Farm to Feedlot Program 2005 to 2011**

| Item | Morbidity category (M)[1] | | | SEM | *P*-value | | | |
|---|---|---|---|---|---|---|---|---|
| | Healthy | ONE | TWO+ | | Healthy vs. treated[2] | ONE vs. TWO+ | Sex | M × sex |
| Treatment cost, $/calf | 0.04 | 25.14 | 58.31 | 0.61 | <0.01 | <0.01 | 0.25 | 0.66 |
| Mean disposition score[3] | 2.1 | 2.2 | 2.2 | 0.08 | 0.04 | 0.86 | 0.02 | 0.02 |
| Initial BW, lb | 741 | 713 | 701 | 17.5 | <0.01 | 0.28 | <0.01 | <0.01 |
| Feedlot ADG, lb/d | 3.43 | 3.30 | 3.15 | 0.09 | <0.01 | 0.06 | <0.01 | 0.55 |
| Final BW, lb | 1,256 | 1,246 | 1,231 | 13.1 | 0.02 | 0.22 | <0.01 | 0.13 |
| Days on feed, d | 154 | 157 | 155 | 3.9 | 0.07 | 0.66 | 0.34 | 0.56 |
| Marbling score[4] | 511 | 509 | 515 | 6.4 | 0.89 | 0.55 | <0.01 | 0.47 |
| USDA QG[5] | 18.4 | 18.4 | 18.4 | 0.11 | 0.93 | 0.93 | <0.01 | 0.59 |
| HCW, lb | 774 | 765 | 763 | 7.9 | 0.03 | 0.83 | <0.01 | 0.27 |
| Dressing percent, % | 61.5 | 61.5 | 61.2 | 0.13 | 0.30 | 0.18 | 0.16 | 0.66 |
| Retail product, % | 63.9 | 64.1 | 64.6 | 0.25 | 0.05 | 0.13 | 0.27 | 0.44 |
| Backfat thickness, in | 0.45 | 0.43 | 0.41 | 0.015 | <0.01 | 0.41 | 0.06 | 0.50 |
| KPH, % | 2.2 | 2.2 | 2.1 | 0.06 | 0.64 | 0.19 | 0.42 | 0.30 |
| LM area, $in^2$ | 12.8 | 12.7 | 12.9 | 0.14 | 0.76 | 0.38 | 0.02 | 0.12 |
| LM area per unit HCW, $in^2$/cwt | 1.66 | 1.68 | 1.71 | 0.17 | 0.03 | 0.21 | 0.04 | 0.30 |
| Calculated YG | 2.92 | 2.86 | 2.73 | 0.063 | 0.04 | 0.15 | 0.42 | 0.46 |
| Final live value, $/calf | 1,107.22 | 1,074.95 | 1,052.24 | 19.14 | <0.01 | 0.12 | <0.01 | 0.25 |
| Net return from finishing, $/calf | 46.74 | -14.05 | -141.95 | 14.00 | <0.01 | <0.01 | 0.02 | 0.24 |

[1]Number of medical treatments per head: healthy = no treatment; ONE = 1 treatment; TWO+ = 2 or more treatments.
[2]Treated = ONE and TWO+ combined.
[3]A disposition score (Beef Improvement Federation 6-Point Scoring System: 1 = docile and 6 = very aggressive) was assigned at on test weighing, re-implant time, and pre-harvest. Disposition scores were averaged to calculate a mean disposition score
[4]Marbling score: Slight = 400-499; Small = 500-599.
[5]USDA quality grade: $Select^-$ = 17; $Select^+$ = 18; $Choice^-$ = 19.

The effect of finishing net return quartile on feedlot performance, carcass traits, and finishing economics appears in Table 3. No differences ($P > 0.05$) among finishing net return quartiles were found for mean disposition score or LM area per unit HCW. However, feedlot ADG, final BW, marbling score, USDA QG, HCW, LM area, final live value, and net return from finishing decreased ($P < 0.05$) progressively as finishing net return quartile declined progressively from the top to bottom. Morbidity rate was greatest ($P < 0.05$) for the bottom quartile, intermediate ($P < 0.05$) for the third quartile, and least ($P < 0.05$) for the top and second quartiles. Similarly, treatment cost was greatest ($P < 0.05$) for the bottom quartile and less ($P < 0.05$) for the top compared to third quartile. Initial BW was greater ($P < 0.05$) for the top compared to third quartile and least ($P < 0.05$) for the bottom quartile. Days on feed

were greatest ($P < 0.05$) for the top quartile but not different ($P > 0.05$) among the second, third, and bottom quartiles. Dressing percent and retail product were greatest ($P < 0.05$) for the top quartile, intermediate ($P < 0.05$) for the second and third quartiles, and least ($P < 0.05$) for the bottom quartile. Backfat thickness was least ($P < 0.05$) for the top quartile and less ($P < 0.05$) for the second than bottom quartile. The bottom quartile had the greatest ($P < 0.05$) KPH, and the top quartile had less ($P < 0.05$) KPH than the third quartile. Finally, calculated YG was least ($P < 0.05$ for the top quartile, intermediate ($P < 0.05$ for the second and third quartiles, and greatest ($P < 0.05$ for the bottom quartile. This is consistent with the findings of Gadberry and Troxel (2006). They found that treatment cost, feedlot ADG, HCW, YG, and QG were significant sources of variation in finishing net return for Arkansas Steer Feedout Program calves.

**Table 3. Effect of finishing net return quartile on feedlot performance, carcass traits, and finishing economics, Mississippi Farm to Feedlot Program 2005 to 2011**

| | Finishing net return quartile (Q) | | | | | *P*-value | | |
|---|---|---|---|---|---|---|---|---|
| Item | Top | Second | Third | Bottom | SEM | Q | Sex | Q × sex |
| Morbidity rate, % | 7.1[c] | 8.8[c] | 12.8[b] | 19.0[a] | 2.44 | <0.01 | 0.39 | 0.34 |
| Treatment cost, $/calf | 2.04[c] | 2.72[bc] | 3.69[b] | 7.75[a] | 0.944 | <0.01 | 0.05 | 0.72 |
| Initial BW, lb | 746[a] | 738[ab] | 733[b] | 724[c] | 16.3 | <0.01 | <0.01 | 0.07 |
| Mean disposition score[1] | 2.1 | 2.1 | 2.1 | 2.1 | 0.07 | 0.24 | 0.05 | 0.42 |
| Feedlot ADG, lb/d | 3.60[a] | 3.47[b] | 3.39[c] | 3.23[d] | 0.087 | <0.01 | <0.01 | 0.57 |
| Final BW, lb | 1,295[a] | 1,261[b] | 1,243[c] | 1,219[d] | 11.7 | <0.01 | <0.01 | 0.42 |
| Days on feed, d | 158[a] | 154[b] | 153[b] | 154[b] | 3.4 | <0.01 | 0.33 | <0.01 |
| Marbling score[2] | 535[a] | 515[b] | 500[c] | 491[d] | 4.5 | <0.01 | <0.01 | 0.11 |
| USDA QG[3] | 18.8[a] | 18.4[b] | 18.2[c] | 17.9[d] | 0.07 | <0.01 | 0.01 | 0.02 |
| HCW, lb | 803[a] | 777[b] | 764[c] | 746[d] | 7.3 | <0.01 | <0.01 | 0.64 |
| Dressing percent, % | 62.1[a] | 61.6[b] | 61.5[b] | 60.9[c] | 0.07 | <0.01 | 0.09 | 0.76 |
| Retail product, % | 64.4[a] | 64.0[b] | 63.8[b] | 63.5[c] | 0.19 | <0.01 | <0.01 | 0.20 |
| Backfat thickness, in | 0.43[c] | 0.44[b] | 0.45[ab] | 0.46[a] | 0.010 | <0.01 | <0.01 | 0.41 |
| KPH, % | 2.1[c] | 2.1[bc] | 2.1[b] | 2.3[a] | 0.05 | <0.01 | 0.06 | <0.01 |
| LM area, in$^2$ | 13.2[a] | 12.8[b] | 12.6[c] | 12.4[d] | 0.10 | <0.01 | <0.01 | 0.64 |
| LM area per unit HCW, in$^2$/cwt | 1.66 | 1.66 | 1.66 | 1.67 | 0.013 | 0.43 | 0.19 | 0.74 |
| Calculated YG | 2.80[c] | 2.90[b] | 2.92[b] | 2.99[a] | 0.045 | <0.01 | 0.01 | 0.28 |
| Final live value, $/calf | 1,186.90[a] | 1,125.39[b] | 1,083.21[c] | 1,021.71[d] | 17.19 | <0.01 | <0.01 | <0.01 |
| Net return from finishing, $/calf | 115.65[a] | 59.33[b] | 20.70[c] | -44.43[d] | 11.92 | <0.01 | <0.01 | <0.01 |

[a,b,c,d]Means with different superscripts within row differ ($P < 0.05$).

[1]A disposition score (Beef Improvement Federation 6-Point Scoring System: 1 = docile and 6 = very aggressive) was assigned at on test weighing, re-implant time, and pre-harvest. Disposition scores were averaged to calculate a mean disposition score.

[2]Marbling score: Slight = 400-499; Small = 500-599.

[3]USDA QG: Select$^-$ = 17; Select$^+$ = 18; Choice$^-$ = 19.

## Implications

In general, as diposition score increased, indicating less desirable temperaments, feedlot ADG, final BW, backfat thickness, calculated YG, final live value, and net return from finishing decreased. In addition, calves that were medically treated had lesser feedlot ADG, HCW, backfat thickness, calculated YG, final live value, and net return from finishing than their healthy counterparts. Finally, calves with lesser morbidity, treatment cost, backfat thickness, and calculated YG and greater feedlot entry weight, feedlot ADG, final BW, HCW, dressing percent, percent retail product, LM area, marbling score, and USDA QG had greater finishing net return. These results indicate the importance of selection for docile disposition and implementation of effective health management protocols. Charactertistics of fed cattle and their carcasses that result in greater finishing net return include less-morbid, faster-growing cattle that result in heavier carcass with more desirable USDA QG and calculated YG.

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# B-Mode Ultrasound Diameter of the Uterine Arteries: An Index of Blood Flow to the Uterus During the Estrous Cycle in Beef Cows?

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## Research Summary

The volume of blood flow in an artery or vein regulates the diameter of the vessel. An increased volume of blood results in larger diameters of the vessel. In the present study, B-Mode ultrasonography was used to assess the diameter of the uterine arteries (UAD) during the estrous cycle of eight Angus crossbred cows. A significant increase (P = 0.02) in UAD was observed between D 0 (4.12 ± 0.10 mm; AI day) and D 16 (4.55 ± 0.11 mm; maternal recognition of pregnancy or luteolysis day). This represents a 10% increase in UAD during this period. The observed trend in UAD may be associated with the development and maintenance of the corpus luteum (CL) during the estrous cycle. No significant differences (P = 0.74) were observed between non-pregnant and pregnant cows at this early stage of potential pregnancy. Further studies are needed for validation of this technique.

## Introduction

An adequate volume of blood is essential not only for keeping the body alive, but also for maintaining normal physiology of its different organs. The cows reproductive organs require an increase in blood flow in order to sustain the reproductive process (Bollwein et al., 2002) and the volume of blood flowing through a blood vessel directly and positively regulates its dimensions (Paniagua et al., 2001).

Doppler ultrasonography has broadly been used to study the blood flow in the reproductive tract of different species. However, this technology requires real-time measurements and the movement of temperamental animals (i.e. beef cattle) makes the use of this tool difficult. Also, in order to obtain volume of blood flow values, control of the angle between the ultrasound waves and the blood flow (insonation angle) is essential (Herzog and Bollwein, 2007) and requires training and practice in the farm environment where these conditions represent considerable difficulty.

To our understanding, the diameter of the uterine arteries has not been used in an intensive way to study the changes in blood perfusion of the reproductive organs during the entire estrous cycle in beef cows. Therefore, a preliminary study using B-Mode ultrasound of the uterine arteries (as a noninvasive technique) was performed with the objectives to achieve a better understanding of the dimensional changes of the uterine artery during the estrous cycle and to study the feasibility of this technique as a research tool during the reproductive cycle in beef cows.

## Procedures

Eight non-pregnant Angus crossbred cows at the Brown Loam Branch Experimental Station, Raymond, MS (Mississippi Agricultural and Forestry Experiment Station, Mississippi State University (MSU)) were utilized in a 20 days experiment in compliance with the MSU Institutional Animal Care and Use Committee. Animals were provided with water, mineral block and hay *ad libitum* throughout the duration of the experiment. Cows were synchronized with the CO-Synch + CIDR protocol (Lamb et al., 2001) and artificially inseminated (AI) using semen from the same bull and by the same technician. The diameters of the uterine arteries were measured using B-Mode ultrasonography at AI (D 0), and at D 3, 6, 10, 16, and 20 post-AI using a SonoSite, M-Turbo (version 1.2.6.) equipped with a L52X/10-5MHz transducer (SonoSite, Inc., 21919 30$^{th}$ Drive SE Bothell, WA 98021 USA). Measurements were collected in triplicate and mean for each side (left and right) was utilized in the statistical analysis. At D 45 after AI, pregnancy was determined by transrectal ultrasonography.

*Statistical Analysis.* The diameters of the uterine arteries were analyzed using the GLM procedure of SAS (SAS Inst. Inc., Cary, NC). The dependent variable in the model was diameter of the uterine arteries and the independent variables were: day, location of artery (left or right) and pregnancy status. There were no significant differences between the diameter of the left and right uterine arteries ($P = 0.38$), therefore data were combined for further analysis. Significant differences in the means of main effects were separated using a Tukey test. Differences were declared significant when $P \leq 0.05$.

## Results

Bollwein et al., (2002) reported a correlation value of 0.48 ($P < 0.01$) between the diameter and the volume of blood flow in the uterine arteries of pregnant cows. Moreover, the flow volume in any blood vessel in the body has a positive and direct relationship with its dimensions (Paniagua et al., 2001). Therefore, in the current experiment, the diameters of the uterine arteries were measured as an index of the status of blood perfusion in the reproductive tract during the estrous cycle. In this study, data generated with the B-Mode ultrasound indicated that this technique is sensitive enough ($P = 0.02$) to decipher the changes in artery diameter that occur during the estrous cycle in beef cows (Figure 1). The overall UAD was 4.12 ± 0.10 mm on D 0 (day of AI) and 4.55 ± 0.11 mm on D 16 ($P = 0.02$). This implies that from the day of AI, when the cows were in estrus, through D 16 post-AI there was a significant increase in artery diameter of 0.43 mm. The Time Average Maximum Velocity (TAMV) is a Doppler Ultrasound parameter used in the study of the uterine blood flow because of its direct and positive association with this parameter (Bollwein et al., 2000). Bollwein et al. (2000) reported a trend in the TAMV of uterine arteries during the bovine estrous cycle similar to the one observed in UAD in the current study. They found lowest and highest values in TAMV during D 0 to 1 of the present cycle being measured, and 3 to1 d before the next estrous cycle. In the current study, this increment represented a 10% increase in UAD from D 0 to D 16. Similarly, Honnens et al., (2008) reported a significant increase of 27% in the TAMV of the uterine arteries blood flow during the estrous cycle in cows. After the day of estrus (D 0), the CL in non-pregnant and early pregnant cows begin to develop at approximately D 2 to 3 and continues

further development until D 15 to 17 (Table 1; Miyamoto et al., 2000; and Murakami et al., 2001). Days 15 to 17 after estrus and subsequent CL development, is the critical period for either maternal recognition of pregnancy or luteolysis (Bearden et al., 2004). This may explain why no differences were observed (Figure 2; $P = 0.74$) in UAD between pregnant and non-pregnant cows, but would expect a difference to occur as pregnancy advances and the non-pregnant cows return to estrus. The significant increase in UAD (and subsequently in blood flow) observed in the present study may be essential to meet the increasing demands of the CL. Because pregnant and non-pregnant cows should have a functional CL during this period, no significant differences were expected. Studies assessing blood flow in pregnant cows after the first 21 days of gestation are needed to determine if this technique may be a feasible index of blood perfusion during this stage.

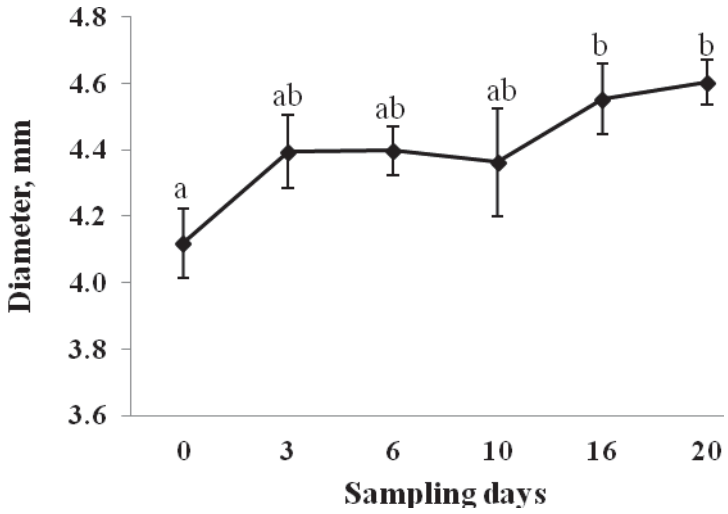


**Figure 1. Diameter of the uterine arteries (means ± SEM) during the estrous cycle in beef cows. [ab] Means without a common superscript differ ($P = 0.02$).**

**Table 1. Phases of the bovine estrus cycle. (Miyamoto et al. (2000) and Murakami et al. (2001))**

| Phase | Estrus | Early Luteal I | Early Luteal II | Mid Luteal | Late Luteal | Follicular |
|---|---|---|---|---|---|---|
| Day | 0 | 2-3 | 5-6 | 8-12 | 15-17 | 19-21 |

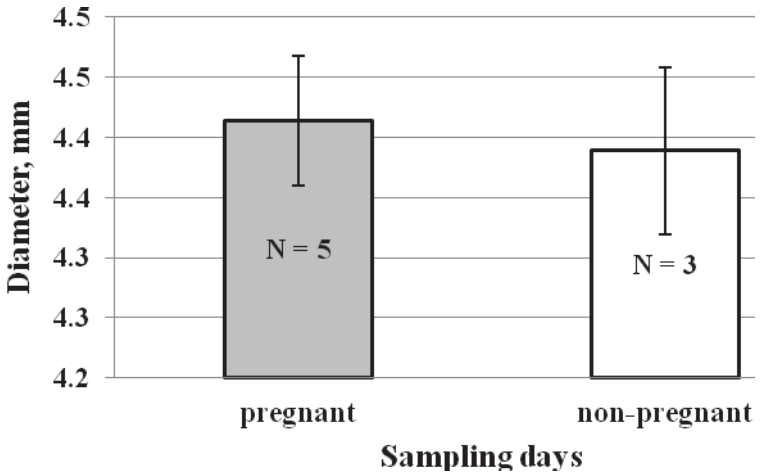


**Figure 2. Overall diameter of uterine arteries (mean ± SEM) during the first 20 days post-AI in pregnant (gray bar) and non-pregnant (white bar) cows (*P* > 0.05). N = number of animals in each group.**

## Implications

The similarities between data from this experiment and previous results published by others using already established techniques for measuring blood flow (i.e. Doppler sonography) set up the potential of using B-Mode ultrasound diameter as a non-invasive research tool with potential to overcome existing problems with established techniques including animal movements and insonation angle maintenance. However, experiments involving an increased number of animals and animals at different reproductive stages are required to achieve a better understanding of the potential of this technique.

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# Body Temperature: Temperament and Sex Effects in Weaned Beef Calves

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## Research Summary

Stress affects temperamental (excitable) beef cattle resulting in physiological changes including body temperature increases. Fifty-two Angus crossbred weaned calves classified as either temperamental or calm were monitored for rectal and superficial body temperature during normal chute management. Temperamental animals had higher ($P$ = 0.02) rectal temperature values than calm ones (102.60 ± 0.14 and 101.93 ± 0.09ºF, respectively). There was a tendency ($P$ = 0.09) for higher superficial temperature values in the temperamental group in comparison with the calm ones (79.74 ± 0.51 and 77.20 ± 0.64ºF, respectively). Heifers tended ($P$ = 0.06) to have higher rectal temperature than steers (102.56 ± 0.12 and 102.00 ± 0.11ºF, respectively). The coefficients for correlation between rectal and superficial temperatures were 0.38 ($P$ = 0.06) and 0.02 ($P$ = 0.90) for temperamental and calm animals, respectively. Body temperature, especially rectal (core body) could be used as an index for animal temperament under normal farm management conditions.

## Introduction

In excitable cattle, normal management practices can be a significant source of stress which can potentially result in decreased performance. During stress exposure, those animals will respond by making physiological adaptations in order to survive. Heat production increases as a result of muscular activity or heat transferred from the core body to the superficial organs. These modifications may be reflected in body temperature changes which may be indicative of the animal's temperament status. Anatomical and physiological differences between sexes (i.e. body fat reserves) may affect the capacity in which the animal deals with those thermal changes. Therefore, the objective of this study was to determine the relationship between temperament (calm vs. excitable), sex (heifers vs. steers), and the body temperature in weaned Angus crossbred calves.

## Procedures

Fifty-two Angus crossbred weaned calves at the Brown Loam Branch Experimental Station, Raymond, MS (Mississippi Agricultural and Forestry Experiment Station, Mississippi State University (MSU)) were utilized in compliance with the MSU Institutional Animal Care and Use Committee. Two weeks post-weaning, heifers (n = 23; 268.04 ± 22.84 days of age and 486.62 ± 69.76 lb of body weight) and steers (n = 29; 256.55 ±

22.37 days of age and 476.79 ± 71.98 lb of body weight) were classified in temperamental (excitable) or calm groups by means of the temperament score. Briefly, after measuring the exit velocity (m/s; Curley et al., 2006) and pen score (in a 1-5 scale, 1 = calm and 5 = very excitable; Hammond et al., 1996) the temperament score (Burdick et al., 2010a) was calculated by the following formula:

Temperament Score = (EV + PS) / 2

where EV is exit velocity and PS is pen score.

The higher the temperament score value, the more excitable the calf. After calculating the overall temperament score mean and standard deviation (SD) for the population of weaned calves, animals with a temperament score ≥ 1 SD above the population mean were classified as temperamental or excitable (≥ 4.26 ± 0.36; n = 11 heifers and 14 steers) and those with temperament score ≤ 1 SD below the population mean were classified as calm (≤ 1.44 ± 0.20; n = 12 heifers and 15 steers) (Burdick et al., 2010b).

After normal pre-weaning management practices (i.e. separation from the dam, sorting pen, and crowding pen), calves were restricted in a squeeze chute and the rectal and superficial temperature were recorded. Rectal temperature was recorded using a GLA Agricultural Electronics model 525-550 with a stainless steel probe of 4.5 inches of length completely inserted in the rectum. The probe was kept in the rectum until a stable measurement was obtained (60-90 seconds). Superficial temperature was recorded over the hair in the right jugular groove region of each animal using an Extech Thermometer Infrared Laser Model # AC107 at an angle of ~ 90° and a distance of ~30 inches from the neck surface.

*Statistical Analysis.* Calf body temperature data was analyzed using the GLM procedure in SAS. The dependent variables in the models were rectal and superficial temperatures and the independent variables were sex and temperament. Significant main effect means were separated using a Tukey's test in SAS. Simple correlation coefficients between rectal and superficial temperatures were calculated using the Corr procedure in SAS. Significant differences and tendencies were determined using P-values ≤ 0.05 and 0.06 - 0.10, respectively.

## Results

In the present study a tendency ($P$ = 0.06) toward a higher rectal temperature in heifers (102.56 ± 0.12ºF) than in steers (102.00 ± 0.11ºF) (Figure 1) was observed. In mature, cycling or pregnant cattle this trend may be explained by the progesterone production because this steroid has a positive relationship with body temperature (Gil et al., 2001). However, progesterone concentrations were not measured in our study and the heifers sampled were just 268.04 ± 22.84 days of age and 486.62 ± 69.76 lb of body weight. Puberty in beef heifers has been reported to occur between 322 - 446 d of age (Byerley et al., 1987 and Ciccioli et al., 2005) and at a body weight of 649 - 673 lb (Byerley et al., 1987). Also, zeranol, the active ingredient in the growth promoting implants that steers received shortly after birth as a normal management practice in the farm has been reported to improve the ability of Hereford steers to deal with heat stress resulting in lower body temperature in comparison with untreated animals (Smith et al., 1976). However, the effective life of this drug is just 100 - 120

days (ZoBell et al., 2000) and the steers used in the present study were 256.55 ± 22.37 days of age at time of weaning. In addition, body weights in both sex groups were similar ($P$ = 0.64; 486.62 ± 69.76 and 476.79 ± 71.98 lb for the heifers and the steers, respectively). Therefore, the possibility of these compounds or a higher metabolic heat production due to larger body size being responsible for the observed results is limited and other external uncontrolled factors (i.e. body fat) may be the reason for the trends observed in rectal temperature between heifers and steers. In weaned animals, heifers have been reported to have higher intramuscular (Filipcik et al., 2009) and subcutaneous (Elías Calles et al., 2000) adipose tissue than steers. Adipose tissue insulation properties have been signaled as of significant importance in thermoregulation in mammals, including humans (Kuzawa, 1998) and bovines (Vermorel et al., 1989). Therefore, even when fat reserves were not measured in the present study, it can be assumed that more intramuscular and, more importantly, subcutaneous adipose tissue may interfere with heat exchange from the core body to the external environment resulting in storage of body heat with a subsequent increase in body temperature. This assumption is reinforced by the fact that there were no differences ($P$ = 0.64) in superficial temperature between sex groups (78.80 ± 0.56 and 78.12 ± 0.62ºF for heifers and steers, respectively).

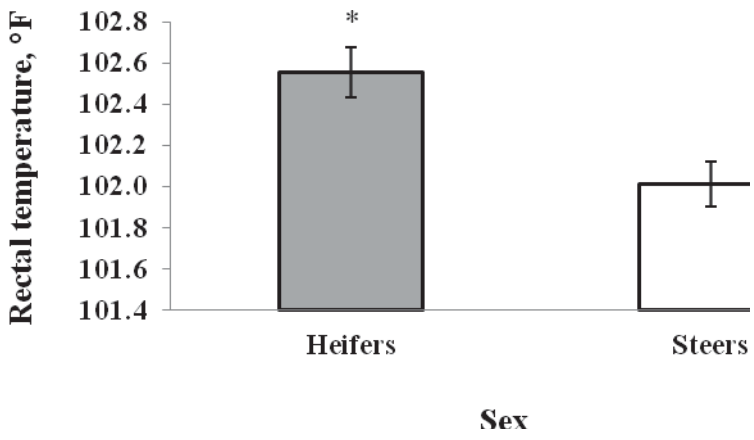


**Figure 1. Effect of sex on rectal temperature (mean ± SEM) in Angus crossbred calves. * Indicate a tendency toward differences between heifers (gray bar) and steers (white bar) ($P$ = 0.06).**

After the stress associated with management and restriction in the working chute, temperamental calves had higher rectal temperature ($P$ = 0.02) than calm ones (Figure 2; 102.60 ± 0.14 and 101.93 ± 0.09ºF, for temperamental and calm, respectively). Burdick et al. (2010a) reported the same trend in rectal temperature in Brahman bulls classified by temperament as a response to the stress associated with transportation. Normal management practices represent a significant source of stress for temperamental animals. During stress, those animals will redirect their blood flow from the internal organs to the skeletal muscles and central nervous system in order

for the "fight or flight" reaction to occur (Sapolsky, 1990). This change in blood flow from the core body to the peripheral organs and heat production associated with increased muscular activity may explain the differences in rectal temperature observed in the present study.

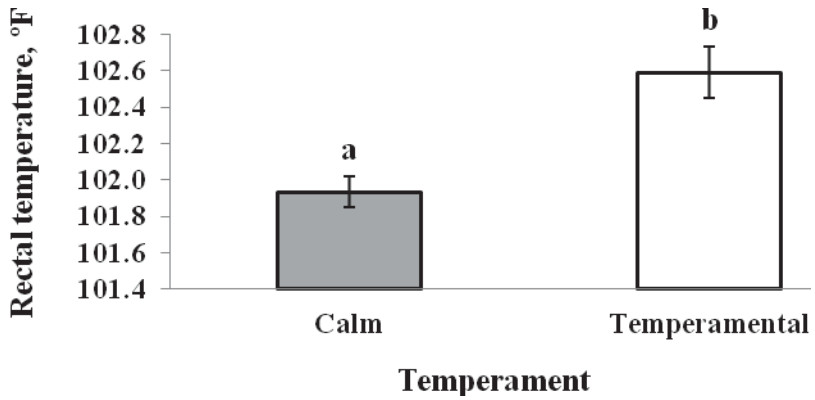


**Figure 2. Effect of temperament on rectal temperature (mean ± SEM) in Angus crossbred calves. [ab] Different superscripts indicate significant differences between temperaments (gray bar= calm; white bar= temperamental; *P* = 0.02).**

Temperamental calves had a tendency ($P = 0.09$) toward higher superficial temperature than calm ones (Figure 3; 79.74 ± 0.51 and 77.20 ± 0.64ºF, respectively). Under normal conditions in docile animals, core body temperature effect over superficial temperature is limited by external environmental factors, resulting in low association between both temperatures. Umphrey et al. (2001) reported that rectal and skin temperature correlation in dairy cows is approximately zero (-0.022 to -0.024). In the present study, temperamental calves had a simple correlation coefficient between rectal and superficial body temperatures of 0.38 ($P = 0.06$). In the calm group, even when not significant ($P = 0.90$), rectal temperature had no effect on superficial temperature ($r^2 = 0.02$). Therefore, in excitable animals the significant increase in core body temperature associated with stress may be of such intensity that it is able to directly affect superficial temperature.

## Implications

Temperament in beef cattle has been broadly studied because its potential negative impact on production and reproductive performance. Therefore, identification of useful research tools that allow for the identification of excitable animals in a simple and immediate way can greatly benefit the beef industry. In the present study, temperament had a significant effect over the body temperature of the animal. Therefore, attention must be directed in future studies to establish feasible anatomical parts for recording body temperature and threshold values that facilitate classification and selection of animals according with their temperaments.

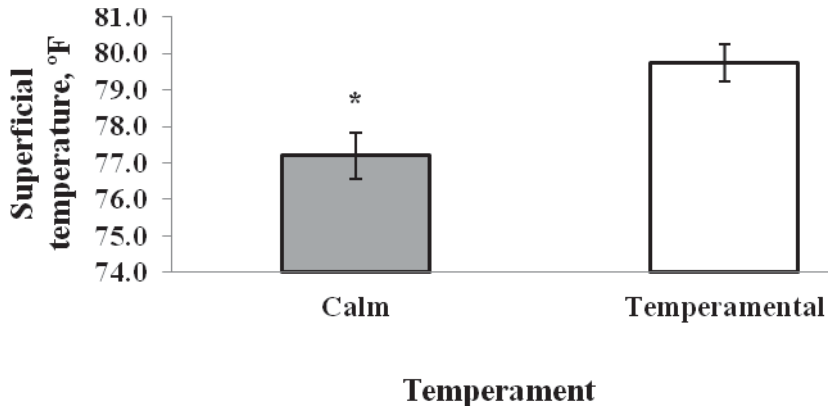


**Figure 3. Effect of temperament on superficial temperature (mean ± SEM) in Angus crossbred calves. * Indicates a tendency toward differences between temperaments (gray bar= calm; white bar= temperamental; *P* = 0.09).**

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# 2011 Dixie National Junior Round-Up

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## Extension Summary

In early February, 4-H youth brought their livestock projects to Jackson for the Dixie National Junior Round-Up Livestock Shows. This show is the showcase for Mississippi 4-H Livestock Programs and site of the largest junior market livestock show in Mississippi. Those animals that received a blue ribbon at their District Livestock Show qualified for the Dixie National Junior Round-Up. Despite difficult economic times, 2,256 animals were exhibited, the most since 2000. These data further support the strength of Mississippians and the dedication and interest that still existed in showing livestock when economic times were challenging for many.

## Introduction

The Dixie National Junior Round-Up is the largest junior livestock show held in Mississippi. Youth and their families begin preparing for this show many months in advance. Much thought and decision goes into selecting the animal for show, and then the process starts to provide the animal with proper nutrition, care, and training of the animal in preparation for show. Through this process, youth learn about aspects of nutrition, reproduction, genetics, selection, and exhibition with their livestock. This enables youth to be competitive in education contests held in conjunction with the Dixie National Junior Round-Up, where scholarships can be won to help with their educations when they reach college. Therefore, the objective of the Dixie National Junior Round-Up livestock shows is to offer youth with the opportunity to showcase the progress they have made with their livestock project in the show ring while providing them with opportunities to obtain monies through education contests to aid them as they pursue postsecondary instruction.

## Procedures

*Qualification for Dixie National Junior Round-Up*

In order to show livestock at the Dixie National Junior Round-Up, youth compete with their animals at 1 of 5 district shows, depending on their county of residence. At these shows, all animals that received a blue ribbon qualified for the Junior Round-Up. In the market shows at the district competition, youth were allowed to show up to 6 market hogs, 6 market goats, 6 market lambs, and 3 market steers. From these animals that qualified, youth were allowed to weigh-in and show 2 market animals in those species at the Dixie National Junior Round-Up. For breeding animals, youth were allowed to enter and show up to 6 beef cattle, 6 dairy cattle, 6 dairy goats, and 6 commercial meat goat does at the Dixie National Junior Round-Up. For the education contests, youth enter competition by submitting applications that were scored prior to on-site competition. In addition, their performance in the remaining aspects of the contests held during the livestock shows contribute to overall rankings.

## Results

One thousand, five-hundred ninety-one 4-H and FFA youth exhibited 2,249 animals at the 2011 Dixie National Junior Round-Up, which was similar to the 2,156 animals exhibited in 2010. The following is a breakdown of the number of entries in 2011 along with the change in number of animals shown from 2011 to 2010 shows in parenthesis: 761 beef cattle (+5); 127 dairy cattle (-39); 688 market hogs (+20); 235 market lambs (+3); 183 market goats (-27); 157 commercial meat goat does (+25); and 98 dairy goats (+6). Exhibitors of market animals were able to show 3 market animals, as long as 1 of the 3 market animals was Mississippi Bred. This change was made for Mississippi producers to be better able to market their animals for shows.

The education contests at the 2011 Dixie National Junior Round-Up had good participation. At the Premier Exhibitor contests, there were 35 participants in the beef division, 11 in the dairy division, 3 in the lamb division, 15 in the swine division and 17 in the goat division, totaling 81 youth who participated in these contests. In the Academic Scholarship Program, awarded by the Sale of Junior Champions, 57 applications were received from which the 25 scholarships were awarded. In addition, the Dixie National Booster Club awarded 6 $1,000 scholarships to the highest placing graduating senior for each species in showmanship.

## Implications

The Dixie National Junior Round-Up was a successful event on a number of levels. Many of the species had increased numbers shown compared to 2010. The valuable information that youth learn about their livestock project enables them to be competitive in the education contests and scholarship program, and the growing number of participants is encouraging. These data show that Mississippi youth are resilient, hard-working individuals who are enjoy the challenges associated with showing livestock and competing for scholarship monies.

# 2011 Dixie National Sale of Junior Champions

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## Extension Summary

The Dixie National Junior Round-Up Livestock Show is the site of the largest junior market livestock show in Mississippi. Each year, the champions and reserve champions in the junior market shows are selected to participate in the Sale of Junior Champions. Of the 1,458 market animals exhibited at 1 of 5 District Livestock Shows, 43 market animals qualified for the 42nd Sale of Champions auction in 2011. These animals sold for $257,162.50, with 80% of the money going to the exhibitor and 20% into a scholarship fund and to pay expenses of the sale. In addition, 33 youth were recognized for their academic accomplishments and successes with breeding animals, and $50,500 was awarded to these individuals. Even though this was a difficult year from a financial standpoint for many buyers and contributors, the hard work of the promotion committee paid off with the monies raised for Mississippi youth.

## Introduction

The Dixie National Junior Round-Up is the largest junior livestock show held in Mississippi. This show culminates each year with the Sale of Junior Champions, where the champion and reserve champion exhibitors in the market shows earn the privilege to sell their animal in a live auction. Youth and their families begin preparing for this show many months in advance in hopes of qualifying an animal for the sale. Much thought and decision goes into selecting the animal for show, and then the process starts to provide the animal with proper nutrition, care, and training of the animal in preparation for show.

Membership on the Sale of Champions Promotion Committee includes adults, businesspeople, and the Extension 4-H Livestock Specialist who are interested in promoting the junior livestock program in Mississippi. These members work diligently to bring potential buyers and contributors to the sale each year to invest in the future of Mississippi youth. The committee seeks to 1) promote the 4-H and FFA livestock program in Mississippi; 2) promote economic, educational and personal development opportunities for youth; and 3) to motivate and increase interest in the junior livestock program. Not only are youth recognized for qualifying their animal for the sale, but other youth exhibitors are rewarded for their achievements in education contests and with their breeding animals.

## Procedures

The Sale of Junior Champions Promotion Committee met several times in the latter part of 2010 to discuss potential buyer and contributor lists. Each committee member was challenged with contacting these businesses and individuals to encourage them to participate in the upcoming sale. The number of animals qualifying for the sale varies each year, with approximately 40 to 43 animals being sold annually. Youth receive 80% of the sale of the animal, while 15% of the money goes into the scholarship fund and 5% covers the expense of the sale. Money in the

scholarship fund was used to recognize youth winning education contests (Premier Exhibitor contests), being a graduating senior without qualifying an animal for the sale (Academic Scholarships), and for exhibiting animals that won supreme awards (Supreme Animal Scholarships).

## Results

One thousand, four-hundred fifty-eight market animals were exhibited at one of five District Livestock Shows in an attempt to qualify for the Dixie National Junior Round-Up. Of these market animals, 1,211 animals were exhibited at the Junior Round-Up from which 43 market animals qualified for the Sale of Junior Champions. The sale included 9 market steers, 13 market hogs, 12 market lambs and 9 market goats. These 43 animals sold for $257,162.50, making it the 17th consecutive year the sale grossed over $100,000. To date, the 42 combined sales have grossed a very impressive $4.5 million dollars.

While the exhibitor is allowed to keep 80% of the money from the proceeds of the animal, 15% of that money is used in the scholarship program. Twenty-five Academic Scholarships (each worth $1,500) were awarded to graduating seniors who did not have an animal that qualified for the sale (totaled $37,500). Fifty-seven applications were received for the Academic Scholarships in 2010. In addition, the Premier Exhibitor contest recognized the winner of each of the 5 species shown (beef, 35 entries; dairy, 11 entries; sheep, 3 entries; swine, 15 entries; and goat, 17 entries) with $2,000 scholarships, totaling $10,000. Finally, the exhibitor of the Supreme Beef Bull, Supreme Beef Female and Supreme Dairy Animal received a $1,000 Supreme Animal Scholarship, totaling $3,000. Altogether, $50,500 in scholarships was awarded to 33 youth by the Sale of Champions Promotion Committee. The scholarship program was initiated in 1993, and to date, 399 scholarships have been awarded for a total of $446,200.

## Implications

Committee members worked diligently in preparing for the 2011 Sale of Junior Champions and were pleased with its outcome and for recognizing the large number of animals that qualified for the sale. Despite difficult economic times, buyers and contributors gave generously and the number of youth served in this program was substantial. These data demonstrate the generosity of Mississippians when it comes to helping put youth in a position to be successful later in life. That is the goal of the Sale of Champions, to work toward the personal development of youth who participate in livestock programs.

# 2011 Mississippi 4-H Congress

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## Extension Summary

Mississippi 4-H Congress is an annual event where senior 4-H youth are given opportunities to compete in educational contests involving livestock. Over the course of a 3-day period, youth compete in visual presentation contests, judging contests, quiz bowl competitions and poster contests. Winning teams in the Meats Judging Contest and Dairy Quiz Bowl advance to represent Mississippi in national competition. Though youth enjoy their time during 4-H Congress, they are very competitive and display knowledge and abilities in a variety of contests.

## Introduction

Mississippi 4-H Congress is an annual state event designed to supplement county 4-H programs. This event provides positive leadership and educational opportunities for senior 4-H members from across the state in an effort to develop these young people to their full potential, allowing them to become productive citizens and catalysts for positive change and ready to meet the needs of a diverse and changing society. In late May, on the campus of Mississippi State University, senior 4-H members (age 14 to18 years) are given opportunities to compete in a variety of livestock-related contests. Senior 4-H members give Visual Presentations related to Beef, Sheep, Swine, Goats, Dairy Animals, and Dairy Foods. There are Meats and Dairy Products Judging Contests in addition to Meats and Dairy Quiz Bowls. State Congress provides 4-H members with friendly competition and opportunities to meet 4-H'ers from across the state, attend educational workshops, and have a lot of fun during their visit to the campus. Therefore, the objective of the Mississippi 4-H Congress is to improve youth's knowledge and skills through experiential learning, life skills training, and leadership development opportunities. In addition, winners in state competitions are selected.

## Procedures

At 4-H Congress, a variety of competitions are offered to senior youth. The Visual Presentation contest is divided into several areas, including Beef, Sheep/Swine/Meat Goat, Dairy Foods, and Dairy Animals Visual Presentations. Youth present on a topic of their choice, using posters or Microsoft PowerPoint to supplement their presentation. In Meats Judging, individuals and teams judge 4 classes of meat product, identify 25 retail cuts of beef, pork and lamb and present 2 sets of oral reasons on 2 placing classes. The winning senior Meats Judging team advances to national competition in Denver, CO. Dairy Products Judging includes scoring samples of milk, cottage cheese, cheddar cheese, and ice cream, rating each sample for overall impression and scoring any taste defects. Two quiz bowls are offered, a Dairy Quiz Bowl and Livestock Quiz Bowl. Dairy Quiz Bowl involves a multi-phase event with a scored quiz and rounds of questions asked to each team. The winning senior Dairy Quiz Bowl team advances to national competition in Louisville, KY. The Livestock Quiz Bowl

was a pilot contest that is designed as a Jeopardy-style contest with questions written from source books about cattle, sheep, swine, meat goats, and dairy goats. The final competition available to youth is a Dairy Poster Contest where youth, ages 8 to 18 years, design a poster based on the national dairy mo motto for that year.

## Results

There was quality participation in the educational contests held during 4-H Congress this past year. In the visual presentations, there were a total of 25 participants (6 in Sheep/Swine/Meat Goat; 12 in Beef; 5 in Dairy Foods; and 2 in Dairy Animals). In Meats Judging, there were 6 teams and 25 youth that competed in the contest. Dairy Products Judging had 4 teams and 23 total youth judging the dairy product samples. In the quiz bowl competitions, Dairy Bowl had 1 team and 5 youth while Livestock Bowl had 3 teams and 12 youth. A total of 46 youth submitted posters in the Dairy Poster Contest using the theme "Pour One More". In this contest, there were 17 participants in the 8 to 10 year old division, 15 participants in the 11 to 13 year old division and 14 participants in the 14 to 18 year old division. Altogether, 136 youth competed in livestock-related educational contests during 4-H Congress.

## Implications

Many people think of livestock shows when the 4-H Livestock Program is mentioned. It is important to emphasize the valuable characteristics youth can learn by giving presentations, judging meats and dairy products and justifying their decisions with oral reasons, and using their knowledge of livestock in quiz bowl competitions. These are productive contests that allow youth to exercise their true capabilities and understandings of what they have learned with their own animals. Participation is always encouraged to allow youth to develop the self-confidence to speak to a group of people about a livestock topic of their interest. It should be noted that for the past 3 years, the Mississippi 4-H State Presidents' main project interests have been the livestock program. These livestock-related educational contests held during 4-H Congress are critical to the 4-H Livestock Program as they allow youth to gain needed experiences in communication and decision-making that will enable them to be successful in life.

# 2011 Mississippi 4-H Horse Championships

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## Extension Summary

The highlight of the year for youth interested in the 4-H Horse Program is the Mississippi 4-H Horse Championships. Many of these youth had to qualify for this show by placing well at one of 4 district horse shows held across the state. In 2011, 626 youth competed at district shows on 1,115 horses, with a total of 2,930 total entries in these shows. Overall, 69 counties had youth represented at the district shows. At the state horse show, 422 youth (representing 62 counties) competed on 642 horses, with a total of 1,393 entries being shown. The district and state shows offered numerous opportunities for junior and senior youth to compete in education contests. Altogether, 252 youth competed in these education contests. In our creative contests, Horse Art, Horse Photography and County T-shirt Design, there were 315 youth entered and 16 counties that submitted entries. The Mississippi 4-H Horse Program was well represented by youth at national contests, attesting to the quality of the youth involved in this program.

## Introduction

The State 4-H Horse Championships is the largest 4-H horse show held in Mississippi. Youth and their families begin preparing for this show many months in advance. Much time and effort goes into training and working with the horse and rider to make them best suited for competition. During this process, youth gain valuable insight regarding proper nutrition for their horse and preparation for the district and state horse shows. In addition to an understanding of nutrition, youth learn about aspects of reproduction, genetics, selection, and exhibition with their horses, thereby enabling them to be competitive in education contests held in conjunction with the State 4-H Horse Championships, where senior winning individuals and teams are selected to represent Mississippi in national contests. Therefore, the objective of the State 4-H Horse Championships is to offer youth the opportunity to showcase the progress they have made with their horses in competition while providing opportunities to use their knowledge and training about horses in educational contests.

## Procedures

There are 2 types of classes offered through the Mississippi 4-H Horse Program: District Only classes where youth must qualify their horses to advance to state competition and State Only classes where youth compete on their horses at the state show without having to qualify for that class. State Only classes require some equipment that all district shows are not able to obtain, such as jumps and fences for over fences classes. At the district horse shows (Northeast: Starkville, MS; Northwest: Batesville, MS; Southeast: Meridian, MS; Southwest: Jackson, MS), all junior (age 8 to 13) educational contests are held, with the top 3 teams and/or individuals (depending on the contest) advancing to compete at the state show against other winning juniors. Senior 4-H youth compete at the state competition held during the state horse

show. During the state horse show, all education contests are held prior to the horse classes. Education contests offered at these shows include Horse Public Speaking, Horse Individual Demonstration, Horse Team Demonstration, Horse Bowl, Horse Judging, and Hippology (senior-only event). In addition, creative contests are offered for youth to compete in as individuals and as a county, including Horse Art, Horse Photography, County T-shirt Design Contest, and County Educational Display Contest. Winners are announced at the Opening Ceremony. Of the classes offered during the state horse show, 50 horses were chosen to advance to the Southern Regional 4-H Horse Championships. Winners of the senior educational contests received some travel support to compete at the Western National 4-H Roundup in the Horse Classic in Denver, Colorado.

## Results

At the District 4-H Horse Shows held in 2011, 626 youth rode 1,115 horses with a total of 2,930 entries. Overall, 69 counties had youth represented at the 4 district shows. At the state horse show, 422 youth (representing 62 counties) competed on 642 horses, with a total of 1,393 entries being shown. At the state show, senior 4-H participation increased in all educational contests. Altogether, 252 youth competed in these educational contests at the district and state horse shows. In our creative contests, 154 youth had exhibits in Horse Art, 143 youth had exhibits in Horse Photography, 16 counties entered the County T-shirt Design Contest and 2 counties entered the County Educational Display Contest.

## Implications

It is important for youth to learn communication skills in 4-H. The Mississippi 4-H Horse Program provides many opportunities for youth to gain valuable experiences in educational contests that will help them as they progress towards college. Competition in these events is friendly but fierce, similar to what is seen in our classes. Mississippi youth performed well at regional and national contests, demonstrating the depth of the quality of youth at these district and state shows.

# 4-H/FFA Beef Heifer Replacement Contest

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## Extension Summary

4-H and FFA livestock projects have been successful at teaching youth and their families about responsibility and care for their livestock. The Replacement Beef Heifer Development Contest is a year-long event where the contestant is personally responsible for the daily management of their heifers. During the year, youth maintain records about their project to justify management decisions. At the end of the contest, they turn in a record book (30% of the contest), have their heifers evaluated (20% of the contest), and make a presentation about their project during an interview (50% of the contest). In the second year of competition, 10 entries were received in November the contest will be completed in August. It is anticipated that youth in this contest will be able to educate adult beef cattle producers about management practices and become good stewards of their cattle.

## Introduction

Livestock shows have always been popular among Mississippi youth. Showing livestock provides youth with a variety of avenues to learn about their animals, including aspects of nutrition, reproduction, genetics, selection, and exhibition. As youth grow in the program, they are better able to utilize and understand this information to make enhanced decisions regarding their livestock projects. A common misconception about livestock shows is that the most successful youth are those who have unlimited resources from which high-quality livestock and equipment can be obtained for shows. This has been known to discourage some youth and families from participating in livestock shows. Some youth, regardless of whether they show cattle, are integral parts of family cattle operations and have obtained experiences that will enable them to make sound heifer management decisions. Therefore, the objective of the Replacement Beef Heifer Development Contest is to recognize those youth that have a true passion for raising beef cattle. In doing so, youth will learn about proper heifer development practices and procedures and can be a positive influence on adult producers involved in raising cattle.

## Procedures

*Contest Design*

The 4-H and FFA Heifer Development Contest is a 12-month project that started on November 1, 2010, and concluded August 13, 2011. Contestants must be 4-H or FFA members who compete as individuals unless 2 or more brothers or sisters (each at least 14 years of age but not over 18 years of age as of January 1 of the year in which the contest begins) of a family constitute a joint entry. If the entrant is in college, he/she must personally manage and care for their heifers on a daily basis by commuting to and from home and school. It is not permissible to have someone else care for contest heifers while away at school.

The heifer development project must consist of 3 heifers (purebred or commercial) that are either autumn born

from the previous year or spring born of the year in which the contest begins. While not mandatory, the heifers can be exhibited in junior shows. Heifers can be purchased from a purebred or commercial producer or be selected from operations of an immediate family member (parent, stepparent, brother, sister, half-brother, half-sister, grandparent, or legal guardian). This contest is designed to evaluate the youth producer's ability to manage the heifers rather than the genetic makeup of the heifers. Therefore, participants using purebred and commercial heifers will be judged together without preference given for breed or breed type. Contestants will be judged on all managerial aspects of their heifer development project. Participants were encouraged to take advantage of Extension agents, advisors, and experienced producers in selecting quality heifers and discussing production costs.

*Evaluation System*

Youth submitted entry forms with a description of the 3 heifers they entered in the contest by November 1, 2010, to the Extension 4-H Livestock Specialist. Initial criteria to be included on the entry form included each animal's age, weight, breed, and starting value (purchase price). In addition, each entrant submitted their goals for the project. If registered heifers were used, the entry included a photocopy of that animal's(s') registration paper.

Heifers chosen for the contest must have been born in the autumn of 2010 or the spring of 2011. Any heifer with a sign of 3-year-old teeth were eliminated at the contest site, regardless of a registered or printed birth date for that heifer.

In order to verify that the 3 animals entered in the contest were the same 3 brought to the contest site, electronic identification (EID) tags were inserted in each heifer's ear at the time of entry. An alternative to using an EID tag included checking an ear tattoo for registered beef heifers to match the tattoo on that heifer's registration paper. Upon arrival to the contest site, all entered heifers were checked to confirm that the heifer was entered in the contest.

The 4-H and FFA Heifer Development Contest consists of 3 components: a visual appraisal of the heifers, a record keeping system, and an interview process.

- **Visual Evaluation:** A committee of judges evaluated each group of 3 heifers managed by youth. Criteria evaluated included weight, frame score, growth, body condition score, health, structural/skeletal soundness, and reproductive ultrasound evaluation. In addition, each entrant was judged on their salesmanship skills and overall knowledge of phenotypic characteristics of their heifers. This component of the contest was worth 20%.

- **Records:** Youth were required to submit records kept throughout the project by August 1, 2011. At the start of the project, contestants were asked to list short- and long-term goals for their heifer project. During each mo of the project, contestants should have recorded management practices performed on his/her heifers. Examples include recording the amount of feed, hay or other nutritional supplements purchased or fed, veterinarian expenses and other health-related costs, breeding decisions, rotational grazing of pastures, a complete budget/expense sheets and any other management

issue in which the youth made a decision for the continued development of his/her heifers. At the conclusion of the project, youth should have addressed whether they achieved their goals set at the start of the project. These records were judged on their completeness and exactness during the contest year. This component of the contest was worth 30%.

- **Interview:** A committee of judges interviewed the exhibitor on their individual production practices. Exhibitors gave a 10 to 15 minute presentation (Microsoft PowerPoint slides or other visual aids) to summarize his/her heifer development project. This presentation included anything relevant to the contestant's project (goals for project and if they were accomplished, pictures to illustrate the project, etc). Each exhibitor then answered questions from the committee in regard to their project, such as the process used to select the heifers, record keeping system used, nutrition program, bull used for breeding purposes, health records and any production practices utilized by the exhibitor during this contest. This component of the contest was worth 50%.

Judges for this contest were chosen from Extension area livestock agents, cattle producers, Extension specialists, and cattle association members. All ties were to be broken using the interview score followed by the record book.

## Results

In the third year of this contest, 12 entries were received. The contest has not been concluded this year to date. Throughout the year, several educational opportunities were made available to youth to assist them with their heifer project.

This contest is a big endeavor for youth, and it was important to reward them justly. While the education and knowledge learned about heifer development will benefit youth long-term, it was important to provide valuable prizes for winning. To date, prizes to be awarded for the Replacement Beef Heifer Development Contest include a bumper-pull livestock trailer, Dell laptop, truck/trailer hitches, cash prizes, and complementary artificial insemination school registrations for all participants. The announcement of winners and awarding of prizes will take place during the Mississippi State Fair and the winner will present what they learned about heifer development at the 2012 Mississippi Cattlemen's Association annual convention.

## Implications

The Replacement Beef Heifer Development Contest provides an authentic experience for youth that choose to participate. Not only do youth learn valuable information that they can use for a lifetime, but the cattle industry benefits as young cattlemen and cattlewomen will be educated producers in the future. These youth can be a positive influence on their own family's cattle production system and share their insights with other cattle producers around the state, causing adults to think more about their own management decisions.

# Applied Cattle Nutrition Workshop

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## Extension Summary

The Mississippi State University Extension Service (MSU-ES) Applied Cattle Nutrition Workshop was conducted in March of 2011. The goal of the project was to allow producers to become more familiar with nutrition and ration formulation. Topics covered in the workshop included: overview of ruminant anatomy and physiology, nutrients in cattle diets, feedstuffs available for cattle production, nutrient requirements of beef cattle, forage budgeting, and a hands-on workshop with various ration balancing software available. Based upon evaluations submitted by participants, the overall program was rated highly, and various suggestions for future nutrition workshops were included.

## Introduction

Costs of purchasing and producing feed for many cattle operations account for at least half of the direct costs (Short, 2001). In order to allow producers to more efficiently use their resources, the MSU-ES conducted an Applied Cattle Nutrition Workshop. The purpose of this workshop was to provide an educational opportunity for producers to learn more about nutrition and to better understand the role nutrients play in cattle production.

## Procedures

The goal of the Applied Cattle Nutrition Workshop was to allow cattle producers (both beef and dairy) an opportunity to learn more about ruminant nutrition, and how that knowledge can be used to help improve commodity choices, and feed utilization, with the end goal of helping to improve the efficiency and sustainability of these operations. Because experiential learning can be a key to retention (Kolb, 1984), it was decided that a hands-on laboratory was needed as well. Since many university websites offer free ration building software, it was determined that the laboratory include a tutorial in which livestock producers would work on these programs in a controlled environment with assistance readily available.

The Applied Nutrition Workshop was advertised through the Cattle Business in Mississippi magazine, on the Internet, and via local Extension offices. Both beef and dairy producers were targeted. The program was held on March 15, 2011, at Mississippi State University in Starkville, MS. The program began at 9:00 a.m., included lunch and concluded at 4:00 p.m. Registration fees covered the cost of lunch, refreshments, notebooks and USB Flash Memory sticks that were given to the participants.

Topics that were covered in the Applied Nutrition Workshop included: review and understanding of the ruminant digestive system, an overview of nutrients in cattle diets, feedstuffs for cattle, nutrient requirements of cattle, forage budgeting, and concluded with a 2-hour lab which allowed participants to work with various ration building programs, for their respective species.

Following the program each participant was encouraged to complete and submit course evaluations. Additionally, participants were given a notebook with more detailed information from the various topics, as well as a USB Flash Memory stick which contained copies of all the free software available.

## Results

Based upon the responses to the evaluations, all responses felt the course provided information that would be useful for their operation to some degree. Most felt the course was long enough, and most felt that the classroom time was well spent. Finally, most felt that this course met their expectations.

On a 1 to 5 scale, with 1 being "poor" and 5 being "excellent", the average rating for all Workshop presentations was 4.4. These ratings for individual topics ranged from 4.0 to 4.8. Some of the comments that may determine future workshops included things such as changing when the course is offered to allow producers to better plan winter feeding and to encourage producers to bring results of their forage tests with them for laboratory exercises.

## Implications

Hands-on learning experiences are considered valuable to cattle producers. However, with topics such as nutrition it is difficult have those experiences. By giving participants the opportunity to work with various software available and reviewing basic nutrition/feed concepts the workshop hoped to improve participant retention and understanding of a very important topic in cattle production.

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# Beef Cattle Boot Camps

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## Extension Summary

The Mississippi State University Extension Service (MSU-ES) Beef Cattle Boot Camps were initiated in 2010 to provide an interactive, hands-on educational opportunity for beef cattle producers on Mississippi Agricultural and Forestry Experiment Station (MAFES) stations. Based upon positive feedback from producers, the program was continued into 2011. Boot Camp topics in 2011 included performance data collection and analysis, calving management, parasite control, animal welfare/behavior, poisonous plant identification, diet transitions, portable fence set up, and freezer beef concepts. Participants rated the presentations highly and provided suggestions for future Boot Camps. A set of Boot Camps is now scheduled to be held on an annual basis each April.

## Introduction

The Mississippi State University Extension Service (MSU-ES) Beef Cattle Boot Camps were initiated in 2010 to provide an interactive, hands-on educational opportunity for beef cattle producers on Mississippi Agricultural and Forestry Experiment Station (MAFES) stations. They were held at the MAFES Prairie Research Unit in Prairie, MS and MAFES Brown Loam Branch Experiment Station near Raymond, MS. Based upon the positive feedback received from these inaugural Boot Camps, it was determined that subsequent Boot Camps be conducted each year. In 2011, the Beef Cattle Boot Camps were conducted at the MAFES Prairie Research Unit in Prairie, MS, and the MAFES White Sand Branch Unit, in Poplarville, MS.

## Procedures

Many MSU-ES beef cattle educational programs focus on complex problems or topics, with the target audience being established beef cattle producers with experience in cattle production. Rather than focus on that target audience, the Boot Camps offered a new approach. They focused on novice producers, who may not have the experience or knowledge of longer established producers. The goal of the Boot Camps was to provide basic information to producers in a hands-on, applicable manner. While the novice group was the ideal target, the Boot Camps also offered the opportunity to established producers to refresh themselves on basic cattle production skills and information.

The Boot Camps were advertised through the Cattle Business in Mississippi magazine, on the Internet, and via local Extension offices. The same program was offered at two locations on different dates to allow participants to choose their preference for program location and date. Boot Camp topics in 2011 included methods to collect and evaluate performance data, calving management, parasite control, animal behavior and welfare scenarios, poisonous plant identification, weed control, diet

transitions, portable fence building and set-up, and freezer beef concepts. Live animal demonstrations were included in the program. Following the program each participant was encouraged to complete and submit course evaluations.

Each Boot Camp program began at 9:00 a.m., included lunch, and concluded at 4:00 p.m. Registration fees covered the cost of lunch, refreshments, Boot Camp notebooks, and other Boot Camp materials. Both MSU-ES and MAFES personnel were involved in the Boot Camp planning and program implementation.

## Results

All participants completing evaluations of the 2011 Boot Camps indicated that the information presented would be useful on their operations. With the exception of one participant all others (n=24) indicated that the length was appropriate. On a 1 to 5 scale, with 1 being "poor" and 5 being "excellent", the average rating for all Boot Camp presentations was 4.5. These ratings for individual topics ranged from 3.9 to 4.9. Previous year average for all topics was 4.2, which indicate that selection of topics for 2011 was appropriate. The topics selected for the 2011 Boot Camps were planned in large part from the suggestions on the participant evaluation forms and verbal feedback from the 2010 Boot Camp attendees. Suggestions from the 2011 Boot Camps for future topics include topics such as hay storage and production, tracking cattle from various sources, vaccinations, and mineral nutrition.

## Implications

Hands-on learning experiences are considered valuable to beef cattle producers, especially novice producers who may require more hands-on experiences to understand basic practices. The Beef Cattle Boot Camps provide opportunities for these experiences while also highlighting MAFES beef cattle research activities. In addition, they facilitate MSU-ES and MAFES personnel interactions with beef cattle producers.

# Mississippi State University Extension Service Artificial Insemination School

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## Extension Summary

The Mississippi State University Extension Service (MSU-ES) Cattle Artificial Insemination (AI) School was initiated in 1997 to provide an applied, practical educational program for beef and dairy cattle producers. The topics covered, location, and instructors have changed over the last decade, but the dedication to delivering a quality educational program has remained strong. Current topics include, reproductive anatomy, estrous cycle, estrus synchronization, equipment, technique practice with bovine reproductive tracts, heat detection and aids, nutritional programs, sire selection, reproductive heard health, biosecurity, semen handling, and technique practice with cattle. Question and answer sessions and individual interaction with instructors are important parts of the course. The MSU-ES Cattle AI School is held twice annually in the spring and autumn of the year and continues to attract participants from across the U.S. Participant evaluations indicate that the program is achieving its educational goals.

## Introduction

Beef and dairy cattle producers utilize AI to introduce superior genetics into their herds and increase profitability. The MSU-ES Cattle AI School was initiated in 1997 to support producer demand for an applied, hands-on educational program about cattle AI. The MSU-ES Cattle AI School started as an annual program taught at the Mississippi Agricultural and Forestry Experiment Station (MAFES) Prairie Research Unit in Prairie, MS. The school moved to the Mississippi State University (MSU) main campus in 2007 to better utilize the cattle, facilities, and faculty available on campus. It is currently conducted at the MAFES Bearden Dairy Research Unit and in Animal and Dairy Sciences department classrooms. Registration fees cover the cost of AI supplies, notebooks, a mid-day meal, and refreshments for the participants. Instructors for the school include MSU faculty, Extension agents, staff, and graduate students with expertise in relevant subject areas. Both MSU-ES and MAFES personnel are involved in program implementation.

## Procedures

Objectives of the MSU-ES Cattle AI School are to 1) provide a cost-efficient program to educate producers on reproductive management; 2) introduce the basics of cattle reproductive management including hormonal regulation, cattle reproductive anatomy, nutrition, genetics, health, etc.; 3) familiarize participants with AI tools including equipment and protocols; and 4) provide hands-on AI and semen handling experience. The course is offered twice a year in spring and autumn. It is limited to 35 participants per course. Program advantages include classroom, lab, and live animal training by MSU topic experts; individual instruction time for all participants; and up-to-date reference materials, record sheets, and management tools provided as part of the course.

The MSU-ES Cattle AI School is unique from most other AI training programs in that it consists of 7 hours of classroom training. Hands-on laboratory handling of bovine female reproductive tracts is included in this training. The program requires a minimum of 8 hours of hands-on experience with semen handling and cattle insemination technique. Near the course conclusion, participants are required to make a cervical pass in a mature cow with an AI rod to be checked for accuracy by instructors. The course begins on a Thursday evening taking place from 6:00 p.m. to 9:45 p.m., continues on Friday from 8:00 a.m. to 5:00 p.m., and concludes on Saturday from 8:00 a.m. to 12:00 p.m. The classroom training runs through Friday at noon, followed by the technique training, which occupies the remainder of the course time.

## Results

All participants enrolled in the MSU-ES Cattle AI School are requested to complete a course evaluation. The evaluation asks the participant to rank each of the topics and speakers for each subject area on a 1 to 5 Likert-type scale, where 1=poor and 5=excellent. Across all of the MSU-ES Cattle AI Schools that have been offered to date, the overall rating for speakers was a 4.72 and the overall rating for topics was a 4.67.

Questions are included on the evaluation forms to better assess program design, content, and delivery. Questions address the usefulness of the information presented, program length, likelihood of recommending the course to others, course expectations, use of classroom time, and live animal sessions. For the Spring 2011 MSU-ES Cattle AI School, no negative responses to these questions were recorded.

The topics selected for the MSU-ES Cattle AI School are modified based on suggestions from the participant evaluation forms and verbal feedback from the attendees. Previous changes made to the program based on participant comments include relocation of the school from an off-campus location to the MSU campus, inclusion of more MSU faculty and students in instructional roles, creation of a course website, development of MSU-ES authored publications for inclusion in course reference manuals, enhancement of laminated chute side notes for participants to keep, and distribution of maps providing directions from the classroom location to the live animal location.

There is strong demand for the MSU-ES Cattle AI School. The course consistently fills to participant capacity at each offering, with waiting lists formed each time for future offerings. School participation has expanded from primarily Mississippi-based attendees to producer representation from 17 additional U.S. states in the program. In excess of 850 persons have completed the MSU-ES AI School since its inception in 1997.

## Implications

Participants completing the MSU-ES Cattle AI School are exposed to classroom, laboratory, and live animal instruction and provided with a certificate of completion. Course graduates are encouraged to continue AI practice to become highly skilled, accurate technicians. Goals for future AI schools are to keep it updated with current AI recommendations, follow up with past participants, provide supplemental material after course completion, and use participant input to better the program. Course information is online at *msucares.com/livestock/beef/aischool.html*.

# History of Mississippi Beef Cattle Improvement Association Bull Sales, 1969-2011

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## Extension Summary

The Mississippi Beef Cattle Improvement Association (MBCIA) Bull Sale Program has a 42-year history of promoting beef cattle improvement within Mississippi. The present study explores the history from 1969 to 2011 of this program to determine trends relevant to potential MBCIA bull sellers and buyers. This summary of MBCIA bull sales is intended to 1) identify breeds of cattle sold, 2) inform potential consignors and buyers of sale results history in terms of sale price, and 3) analyze body weight and age trends. Results show that while weaning weight and average sale price have continued to increase, birth weight has not changed over time. Sale weight peaked around 2000 then made a steady drop from 2000 to 2011 as many younger bulls were marketed through the program. The number of cattle sold over the decades has decreased over time. The MBCIA Bull Sales offer Mississippi beef cattle breeders and bull test participants with bull marketing opportunities twice a year at very competitive sale expense levels. General sale price averages have held steady over the last 6 years, but sale prices for individual bull lots have been highly variable. This emphasizes the need for high-quality bull consignments to MBCIA bull sales for individual consignors to achieve marketing success through these sales.

## Introduction

The Mississippi Beef Cattle Improvement Association (MBCIA) was established in 1968 for the purpose of unifying beef cattle breeders and promoting beef cattle improvement within Mississippi. The MBCIA is a member of the Beef Improvement Federation, which was formed as a means to standardize beef cattle performance programs and methodology and to create greater awareness, acceptance, and usage of beef cattle performance concepts. The MBCIA membership includes purebred and commercial beef cattle producers, commodity association representatives, and Mississippi State University Extension Service and Mississippi Agricultural and Forestry Experiment Station personnel.

In keeping with its purpose, in 1969 MBCIA initiated a bull sale program with the objective of encouraging production and identification of genetically superior bulls by purebred breeders and promoting the purchase and use of these bulls by commercial producers. The MBCIA bull sale program consists of purebred bull consignment sales open to consignments from Mississippi cattle producers. Out-of-state cattle producers are also invited to nominate bulls for this sale provided the bulls were performance tested on either the Hinds Community College Bull Test, a 112-day grain-based bull performance test established in 1982 in Raymond, MS, or the South Mississippi Gain-on-Forage Bull Test, a 140-day forage-based bull performance test established in 1986 near Tylertown, MS. Additionally, a MBCIA Spring Bull Sale began in 2008 and is held annually in conjunction with the Hinds Community

College Bull Test sale on the first Thursday in March.

Bulls offered through MBCIA sales are required to have passed a breeding soundness examination within 30 days prior to the sale date, met minimum growth and scrotal circumference requirements, and are backed with extensive performance information. Bulls are also screened for structural soundness and other defects such as temperament problems prior to being accepted for sale participation. Over the 42-year history, MBCIA bull sale requirements have been updated on several occasions to reflect industry changes and new performance goals. These changes have impacted both specific bull consignments and sale participations levels.

## Procedures

The MBCIA sale manager, Extension Beef Cattle Specialist, provided sale data from November 1969 to March 2011 for this review. These data included 39 MBCIA Fall Bull Sales from 1969 to 2008 and 5 MBCIA Spring Bull Sales including 1982 and 2008 to 2011. Simple descriptive statistics were determined from the sale data to illustrate price, body weight and age, and breed participation. During the period studied, several noteworthy changes to the sale occurred that should be factored into any interpretation of the results.

The MBCIA Bull Sale started in 1969 under the name of the Gold Seal and Silver Seal Program. The objective of the sale was to offer bulls of modern conformation, measured for growth, and conditioned for breeding. For a bull to receive a gold seal, he must have met these qualifications. Pre-weaning, bulls that had nursed cows other than their own dams were not eligible for sale. Bulls must have been weighed and graded when they were between 150 and 275-days of age under the supervision of the MBCIA. Bulls must have had a weaning record of adjusted average daily gain of 1.90 pounds per day or greater, adjusted 205-day weight of 450 pounds or greater, and graded 12.0 or higher to be eligible for this sale. A 140-day post-weaning gain test was optional. The bulls were required to be developed on a minimum of 2 acres and there be at least 2 head in a contemporary group. The order in which the bulls sold was based on gold seal bulls selling first starting with the oldest and working down. Bulls of gold seal and same age were ordered based on an index comprised of weight per day of age and grade.

The MBCIA directors were established in 1970 and represented each breed association in Mississippi. The selected directors were responsible for on-farm performance testing. In 1971, representatives from Simmental and other exotic breeds were invited to represent their respective breed associations on the MBCIA board of directors. Breeds that were accepted by the USDA as purebred or registered cattle were available for nomination. During this time the association added body type, creep feed, and weaning weight ratio to the sale order. In 1973, ¾ and ⅞ blood bulls were allowed to be nominated to the sale program. Adjusted yearling weight and yearling weight ratio were listed for select bulls in the 1977 catalog for the first time. On-farm screening was provided for the first time by Extension personnel from the Mississippi State University Department of Animal Sciences in 1978. The first spring bull sale was conducted in 1982, and hip height, scrotal circumference measurements, and sale weight were added to sale order information at this time. In 1990, adjusted 205-day weight minimum

requirement was increased to 500 pounds or 450 pounds with at least a 95 ratio and a minimum of 5 contemporaries. Bulls were also required to have expected progeny differences (EPD) and accuracies from their respective breed associations, and actual birth weight had to be reported. The gold and silver seal designations and the listing of creep versus no creep pre-weaning feeding management were removed from the reported program information.

Beginning with the Fall 2006 MBCIA Bull Sale, live broadcasts began from the Raymond sale site over the Mississippi State University Extension Service distance education system. Interactive video bidding sites included in the Panola County Extension office in Batesville, MS and the North MS Research and Extension Center in Verona, MS. To date, several MBCIA Bull Sale bids, including winning bids, have been placed over the interactive video system.

Adjusted 365-day yearling weight requirements were put in place first for the Fall 2005 MBCIA Bull Sale at 850 pounds, increased to 900 pounds with the Fall 2007 MBCIA Bull Sale, and finally set at 1000 lb with the Spring 2008 MBCIA Bull Sale. Eligible bull age ranges were widened to include bulls from 13 to 39 mo of age starting with the Fall 2005 MBCIA Bull Sale and then later narrowed down to 13 to 26 months of age starting with the Spring 2008 MBCIA Bull Sale. Sale eligibility requirements were changed effective with the Fall 2006 MBCIA Bull Sale such that at least one of the following 1) ultrasound EPD, 2) carcass EPD, or 3) ultrasound body composition scan results were required for bulls to meet sale eligibility.

The current objective for the MBCIA Bull Sale is encouraging production and identification of genetically superior bulls by purebred breeders and to encourage the purchase and use of these bulls by commercial producers. The objective of the bull sale has remained constant, whereas the qualifications for the bull sale have changed throughout the years. Sale eligibility requirements were altered over time with the goal of strengthening the overall quality of MBCIA sale offerings.

The current sale order calculation uses a combination of individual performance, EPDs, and general conformation data. A selection index based on the individual bull's score in the following categories is used to rank bulls for determination of sale order (highest scoring sells first); calving ease or birth weight EPD (maximum of 5 points), weaning weight EPD (maximum of 7.5 points), yearling weight EPD (maximum of 7.5 points), actual scrotal circumference (maximum of 5 points), weight per day of age (maximum of 15 points), intramuscular fat or marbling EPD (maximum of 7.5 points), ribeye area EPD (maximum of 7.5 points), and visual appraisal (maximum of 40 points). A 3-person committee assigns subjective visual appraisal scores. An additional 5 points is added to a bull's selection index total if ultrasound body composition scan results are provided.

Furthermore, the bull sale order rewards bulls for achieving specific weight per day of age levels; scrotal circumference levels; and EPD percentile rankings for birth weight or direct calving ease, weaning weight, yearling weight, ribeye area, and intramuscular fat EPD. In addition, bulls move closer to the start of the sale order with high visual appraisal scores and by having documented ultrasound body composition scan results. This has likely impacted the specific bull consignments to

the MBCIA sales by shifting emphasis to performance data and EPD.

The MBCIA Bull Sale Program has a 42-year history. It is worthwhile to explore the history of this program to determine trends relevant to potential MBCIA bull sellers and buyers. The present summary of MBCIA bull sales is intended to 1) identify breeds of cattle sold 2) inform potential consignors and buyers of sale results history in terms of sale price 3) analyze body weight and age trends.

## Results

The number of bulls marketed in MBCIA sales from November 1969 to March 2011 peaked at 724 bulls over the period from 1969 to 1979 (Table 1). The period from 1991 to 2001, marked the largest number of breeds (n = 14) sold. The number of cattle consigned to the sale steadily declined as the years progressed. Angus (n = 839) topped the list for breed of cattle offered over the duration of the program during the period reviewed. The MBCIA Bull Sale has offered 19 different breeds of cattle. Angus (n = 839), Hereford (n = 252), and Polled Hereford (n = 570) were the dominant breeds over the history of the sale. Simmental (n = 157), Charolais (n = 153), and Brangus (n = 106) have sold consistently throughout the history of the sale.

The average sale price per period indicates an increase in average price as years advance. The average price and high selling lots shown in Figure 2 indicate an increase in average price and high selling lot comparing the initiation of the program to the most recent sale results. Actual birth weight has remained fairly constant across the years reported, which started in the early 1980's. Average adjusted 205-day weaning weight increased 125 pounds over the 42-year program span (Figure 3). Age in days decreased in recent years, and this translated to a decrease in sale weight. The recent decrease in sale age in days explains the recent drops in sale body weight. For example the sale age of bulls averaged 708 days in 2007 and dropped to 501 days in 2009, so it is expected that bulls averaging about 7 months of age younger would weigh lighter at sale time. Sale weight per day of age moved steady to upward, reflecting this information.

**Table 1. Number of cattle by breed for the Mississippi Beef Cattle Improvement Association Bull Sale, 1969 to 2011**[1]

| Breed of cattle | 1969-1979, n | 1980-1990, n | 1991-2001, n | 2002-2011, n | Total cattle, n |
|---|---|---|---|---|---|
| Angus | 206 | 124 | 279 | 230 | 839 |
| Red Angus | 1 | 0 | 1 | 1 | 3 |
| Balancer | 0 | 0 | 0 | 1 | 1 |
| Beefmaster | 0 | 14 | 0 | 0 | 14 |
| Brangus | 8 | 66 | 26 | 6 | 106 |
| Brahman | 2 | 5 | 2 | 0 | 9 |
| Charbray | 0 | 1 | 0 | 0 | 1 |
| Charolais | 38 | 37 | 51 | 27 | 153 |
| Gelbvieh | 0 | 0 | 27 | 2 | 29 |
| Hereford | 180 | 52 | 1 | 19 | 252 |
| Polled Hereford | 260 | 268 | 42 | 0 | 570 |
| Limousin | 0 | 0 | 12 | 0 | 12 |
| Red Brangus | 0 | 0 | 2 | 0 | 2 |
| Salers | 0 | 1 | 0 | 0 | 1 |
| Santa Gertrudis | 15 | 16 | 3 | 1 | 35 |
| Simbrah | 0 | 7 | 1 | 0 | 8 |
| Simangus | 0 | 0 | 0 | 2 | 2 |
| Simmental | 11 | 103 | 39 | 4 | 157 |
| Shorthorn | 3 | 0 | 1 | 0 | 4 |
| Total cattle | 724 | 694 | 487 | 293 | 2198 |

[1]The Mississippi Beef Cattle Improvement Association Bull Sales were held in conjunction with the Hinds Community College Bull Test Sale. The values presented here do not include the data from the Hinds Community College Bull Test Sale.

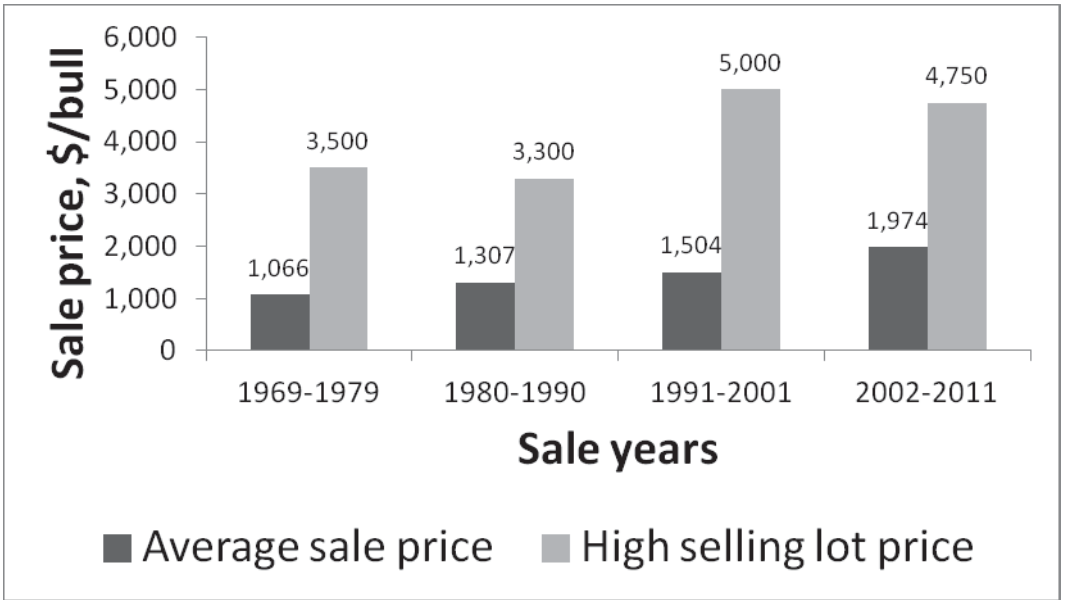



**Figure 1. Sale price trends for the Mississippi Beef Cattle Improvement Association Bull Sale by Period, 1969 to 2011**

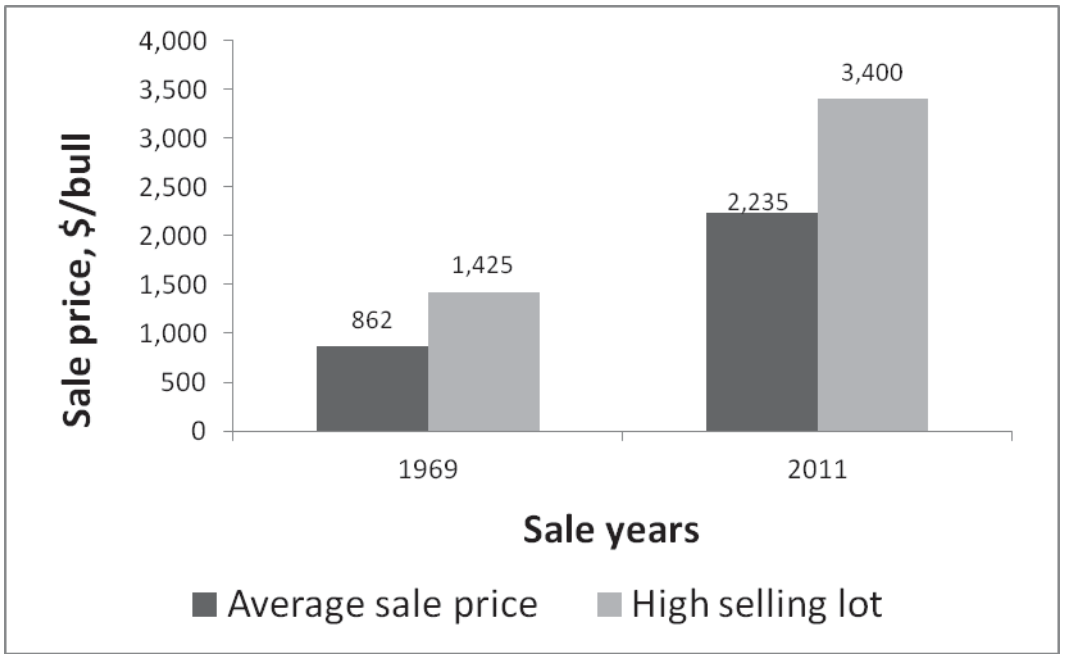
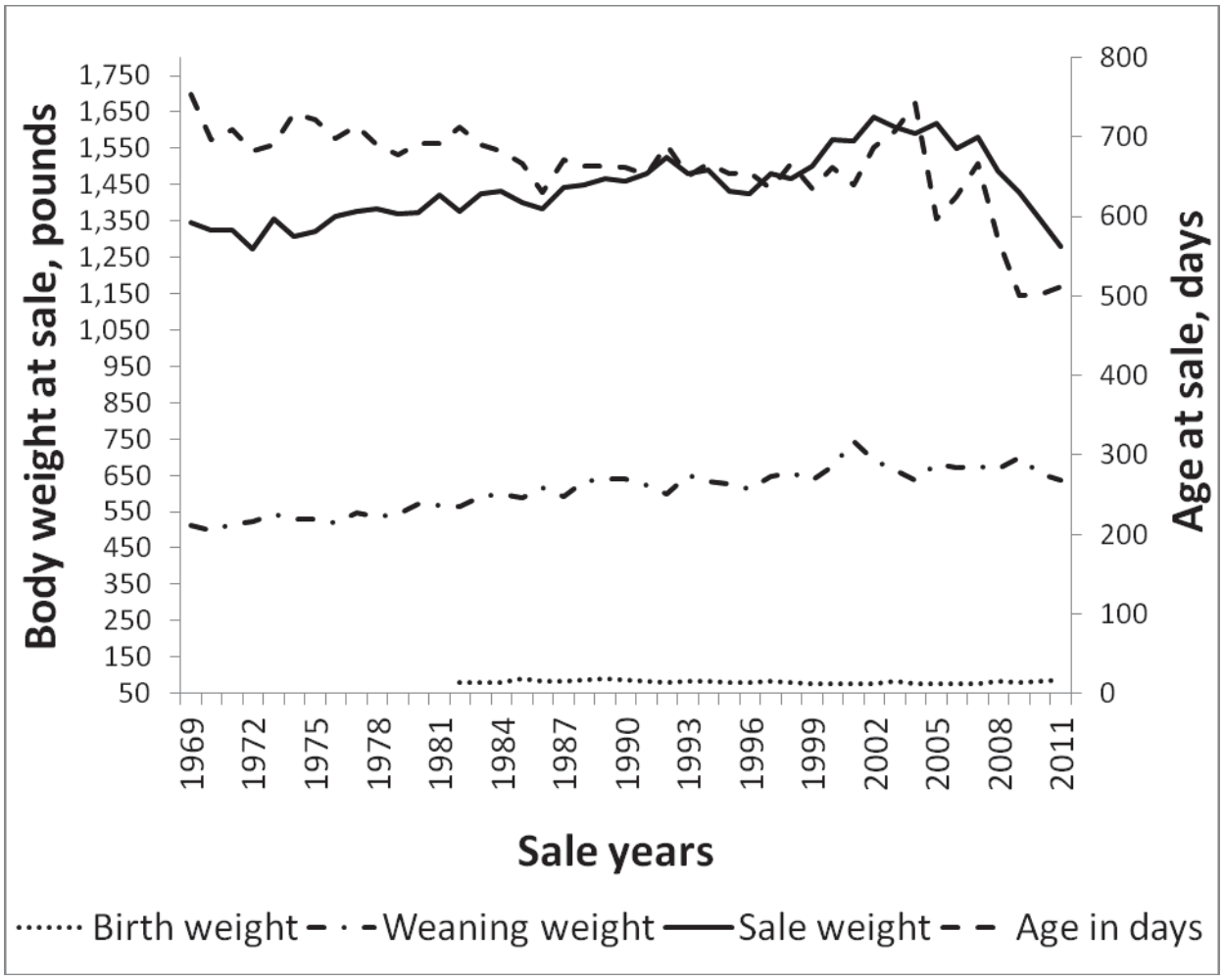



**Figure 2. Sale price trends for the Mississippi Beef Cattle Improvement Association Bull Sale, 1969 and 2011**




[1]Birth weight is a measure of actual birth weight. Weaning weight is an adjusted value for weaning weight. Sale weight is a value measured the day before the sale. Age in days is a measure recorded on day of sale.

**Figure 3. Bull body weight and age trends for the Mississippi Beef Cattle Improvement Association Bull Sale, 1969 to 2011[1]**

## Implications

Mississippi BCIA has a long history of promoting beef cattle improvement and quality genetics through annual bull sales. Potential consignors to MBCIA Bull Sales should consider previous sale results and body weights in making decisions about sale participation. The MBCIA Bull Sales offer Mississippi beef cattle breeders and bull test participants with bull marketing opportunities twice a year at very competitive sale expense levels. General sale price averages have steadily increased over the history of the sale, but sale prices for individual bull lots have been highly variable. This emphasizes the need for high-quality bull consignments to MBCIA bull sales for individual consignors to achieve marketing success through these sales.

# Mississippi Farm to Feedlot Program, 1993 to 2005 Summary

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## Extension Summary

The Mississippi Farm to Feedlot Program is coordinated by the Mississippi State University Extension Service. It provides educational information to beef cattle producers on feedlot performance, carcass characteristics, and finishing economics for weaned calves shipped to feedlots from Mississippi. This report summarizes records of steers (n = 6,392) and heifers (n = 903) consigned to the Mississippi Farm to Feedlot Program from 1993 to 2005 and shipped to Kansas feedlots. It provides statewide benchmarks that producers can use in comparing their own results to program results. The majority of cattle graded Select+ or Choice- for USDA quality grade, but there is room for improvement in the percentages of cattle grading average Choice or better. Most calves received USDA yield grades of 2 or 3, and only small percentages graded 4 or 5. Areas in which improvements to record keeping, breeding, nutritional, and health management of calves are needed can be identified using this information.

## Introduction

The Mississippi Farm to Feedlot Program was established in 1993 to evaluate feedlot and carcass performance for calves produced in Mississippi and to provide educational information to Mississippi beef producers regarding retained ownership as a marketing alternative. It often serves as an introduction to cattle finishing and harvest production and marketing systems for these producers. The program is coordinated by the Mississippi State University Extension Service and is similar to Ranch-to-Rail-type programs offered in other U.S. states.

Beef cattle producers consign weaned calves to the Mississippi Farm to Feedlot Program for feedlot shipment. These farms of origin retain ownership of the calves through harvest. Feedlot performance, carcass characteristic, and financial data are collected on individual calves in the program. This information is then shared with the farms of origin on an individual and overall participant basis. Mississippi State University Extension Service personnel assist in data interpretation and make recommendations to individual producers to improve future results. Specifically, recommendations focus on improvements to breeding, genetics, and herd health management practices. This report summarizes the results of the Mississippi Farm to Feedlot Program for cattle shipped to Kansas feedlots from 1993 to 2005.

## Procedures

Records of steers (n = 6,392) and heifers (n = 903) consigned to the Mississippi Farm to Feedlot Program from 1993 to 2005 were used in this analysis. They represented 203 unique farms of origin and 86 feeding groups.

An on-farm preconditioning program was strongly suggested prior to shipment to the feedlot, but the details of the

preconditioning program were left to the owner's discretion. Calves submitted to the program were accompanied with an enrollment form. The form provided information regarding calf birth date and the owner's knowledge or estimate of sire and dam breed composition. Producers were encouraged to select calves that were representative of their breeding and management programs for enrollment in the Mississippi Farm to Feedlot Program.

Calves were required to have a minimum body weight at shipment to the feedlot of 500 pounds. Each program year, cattle were shipped to a feedlot (Hitch Enterprises, Garden City, KS from program year 1993 to 1994 through 2003 to 2004; DM&M Farms Inc., Cimarron, KS from program year 2004 to 2005 through 2005 to 2006) in autumn (dates ranging from August 21 to November 17, with 16 out of 23 shipment dates occurring between October 2 and October 26). On the day of shipment to the feedlot, calves were weighed and pooled into truckload, 49,000-lb lots at producer farms or Mississippi Agricultural and Forestry Experiment Station sites. Cattle were weighed before shipment to the feedlot, upon arrival at the feedlot (initial body weight), and then again at the end of the feeding period. Cattle were processed and weighed individually. Calves that experienced morbidity were treated according to feedlot protocol.

Cattle were sorted into feeding groups based on initial body weight, frame size, body condition score, and sex by trained feedlot personnel. Single-sex feeding groups were utilized. Feeding groups were composed of cattle from one or more farms of origin in one feeding group, and the number of calves sent per owner ranged from 2 to 32 head. Cattle were offered a feed ration between 24 and 36 hours after arrival to the feedlot. Cattle were fed a traditional feedlot diet with 4 diet changes until cattle were adapted to the finishing diet.

Final body weight was determined prior to shipment to the packer. Cattle were marketed on a live weight basis. All cattle in a pen were harvested when the majority of the pen averaged 0.5 inches of rib fat as determined by feedlot management. Carcass data were collected at time of harvest. The carcass data were collected by individual USDA graders at the following plants responsible for collecting and reporting carcass data: Cargill Meat Solutions Corporation, Cargill Inc., Wichita, KS; Tyson Fresh Meats (formerly IBP), Emporia, KS; and National Beef Packing Co. LLC, Dodge City, KS.

Feed intake data used in calculation of feed cost and feed cost of gain were based on pen feed intake averages, not individual animal intake data. The per-period individual feed cost was determined by the daily pen feed cost per period per number of days an animal was in the pen during that period. Daily pen feed costs per period were then summed over all periods for each animal.

## Results

Mississippi Farm to Feedlot Program feedlot entry characteristics and performance summary results for calves shipped to Kansas feedlots from 1993 to 2005 are presented in Table 1. Overall morbidity rate was 20.6%, and overall mortality rate was 2.0%. Carcass traits are summarized in Table 2. A summary of calf finishing financial performance appears in Table 3.

**Table 1. Mississippi Farm to Feedlot Program feedlot entry characteristics and performance summary, 1993 to 2005**

| Item | Steers | | Heifers | |
|---|---|---|---|---|
| | Mean | Standard Error | Mean | Standard Error |
| Feedlot entry age, days | 304 | 1.1 | 356 | 3.8 |
| Feedlot entry weight, lb | 661 | 1.2 | 683 | 3.0 |
| Feedlot entry weight per day of age, lb/day | 2.22 | 0.01 | 1.97 | 0.02 |
| Initial value, $/cwt | 75.64 | 0.18 | 72.05 | 0.31 |
| Initial value, $/head | 497.48 | 1.34 | 490.87 | 2.83 |
| Final age, days | 493 | 1.0 | 522 | 3.4 |
| Final live weight, lb | 1,193 | 1.5 | 1,116 | 4.1 |
| Average daily gain, lb/day | 3.12 | 0.01 | 3.11 | 0.02 |
| Days on feed, days | 178 | 0.3 | 150 | 0.6 |
| Individual medical treatments, number | 0.6 | 0.02 | 0.4 | 0.04 |

**Table 2. Mississippi Farm to Feedlot Program carcass trait summary, 1993 to 2005**

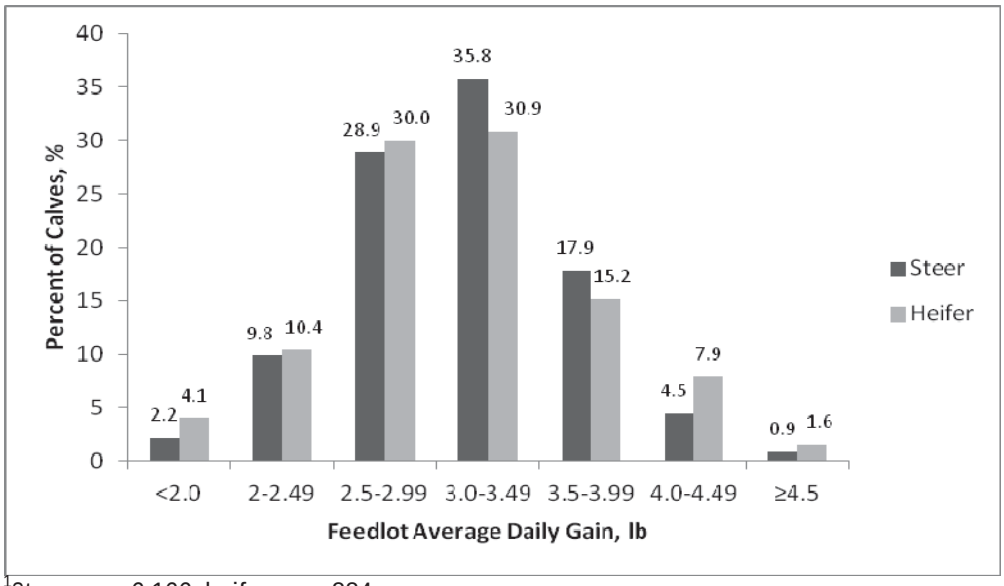
| Item | Steers | | Heifers | |
|---|---|---|---|---|
| | Mean | Standard Error | Mean | Standard Error |
| Hot carcass weight, lb | 764 | 1.1 | 717 | 3.0 |
| Dressing percent, % | 64.0 | 0.03 | 64.4 | 0.11 |
| Backfat thickness, in | 0.48 | 0.003 | 0.51 | 0.008 |
| Ribeye area, $in^2$ | 13.1 | 0.02 | 13.0 | 0.06 |
| Ribeye area per cwt, $in^2$/cwt | 1.73 | 0.003 | 1.83 | 0.008 |
| Calculated yield grade | 2.74 | 0.01 | 2.78 | 0.03 |
| Marbling score[1] | 490 | 1.2 | 525 | 3.6 |
| USDA quality grade[2] | 17.8 | 0.02 | 18.4 | 0.06 |

[1]Marbling score: Slight = 400-499; Small = 500-599.
[2]USDA quality grade: $Select^-$ = 17; $Select^+$ = 18; $Choice^-$ = 19.

**Table 3. Mississippi Farm to Feedlot Program financial summary, 1993 to 2005**

| Item | Steers | | Heifers | |
|---|---|---|---|---|
| | Mean | Standard Error | Mean | Standard Error |
| Medical treatment cost, $/calf | 764 | 1.1 | 717 | 3.0 |
| Feed cost, $/calf | 64.0 | 0.03 | 64.4 | 0.11 |
| Feed cost of gain, $/cwt. gain | 0.48 | 0.003 | 0.51 | 0.008 |
| Net return from finishing, $/calf | 31.21 | 1.81 | 42.46 | 3.94 |

Feedlot average daily gain for individual calves ranged from 0.1 to 5.7 lb per day with an overall average of 3.1 lb per day. The distribution of feedlot average daily gain by calf sex is illustrated in Figure 1. Approximately 8 out of every 10 steers and heifers gained between 2.5 and 3.99 lb per day.

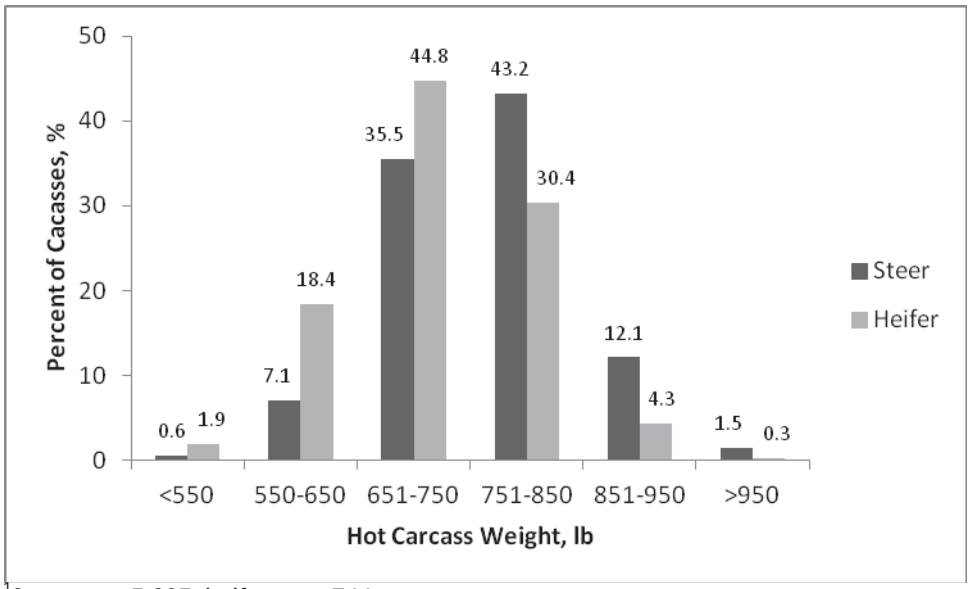



[1]Steers, n = 6,166; heifers, n = 884.

**Figure 1. Distribution of feedlot average daily gains for Mississippi Farm to Feedlot Program calves, 1993 to 2005.[1]**

Hot carcass weight discounts were applied to 136 carcasses outside of the accepted 550- to 950-lb range. Only 0.7% of carcasses were lighter than 550 lb, and 1.4% of all carcasses were heavier than 950 lb.

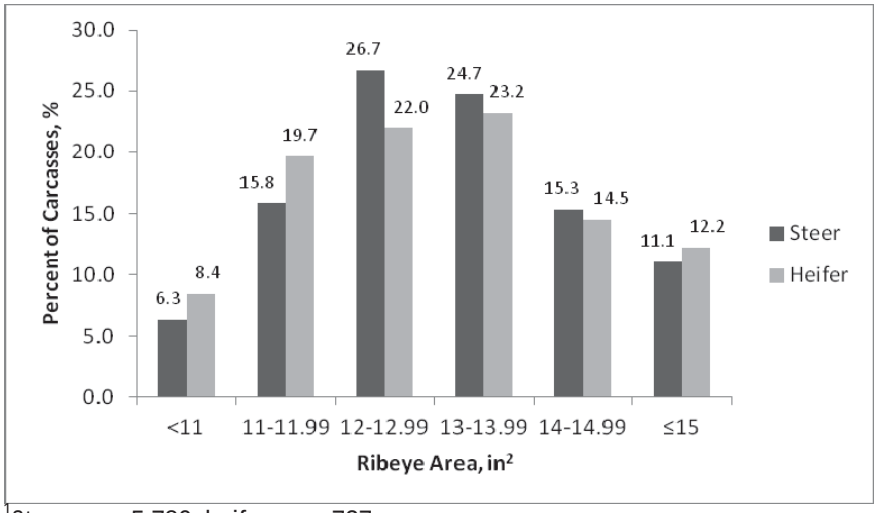
Hot carcass weight distributions for steers and heifers are shown in Figure 2. Nearly 8 out of 10 steer and 3 out of 4 heifer carcasses weighed between 651 and 850 lb.




[1]Steers, n = 5,805; heifers, n = 744.

**Figure 2. Distribution of hot carcass weights for Mississippi Farm to Feedlot Program calves, 1993 to 2005.[1]**

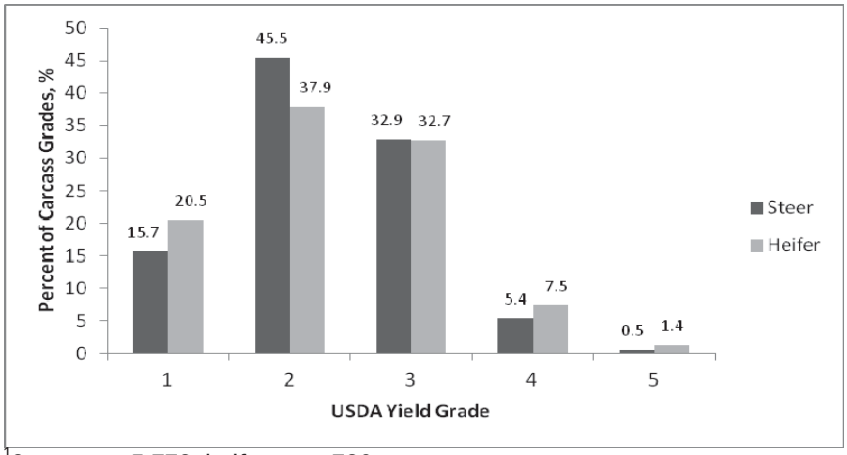
Ribeye area distributions for steers and heifers are shown in Figure 3. The mean ribeye areas for steers and heifers were 13.1 and 13.0 $in^2$, respectively. Just over one-half of steer and nearly half of heifer carcasses had ribeye areas between 12 and 14 $in^2$. Only 1.0% of all carcasses had ribeye areas smaller than 10 $in^2$, whereas 3.7% had ribeye areas larger than 16 $in^2$.




[1]Steers, n = 5,780; heifers, n = 737.

**Figure 3. Distribution of ribeye areas for Mississippi Farm to Feedlot Program calves, 1993 to 2005.[1]**

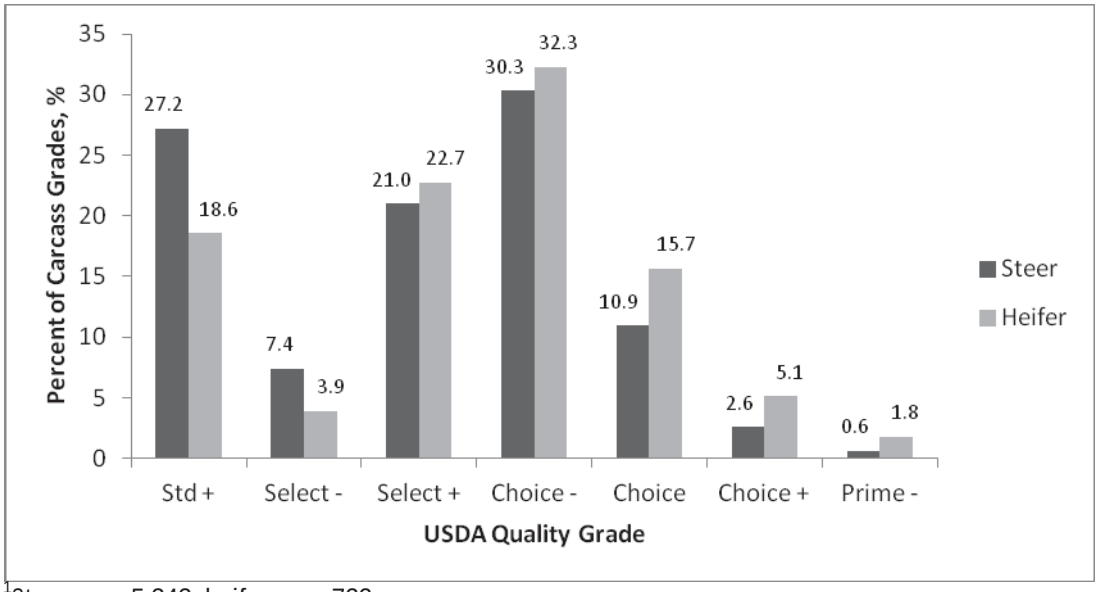
Yield grade distributions for steers and heifers appear in Figure 4. In excess of 61% of steer carcasses were yield grade 1 or 2, and over 58% of heifer carcasses were yield grade 1 or 2. Only 5.9 and 8.9% of steer and heifer carcasses, respectively, were yield grade 4 or 5. The mean calculated yield grades were 2.7 and 2.8 for steer and heifer carcasses, respectively.




[1]Steers, n = 5,772; heifers, n = 736.

**Figure 4. Distribution of USDA yield grades for Mississippi Farm to Feedlot Program calves, 1993 to 2005.[1]**

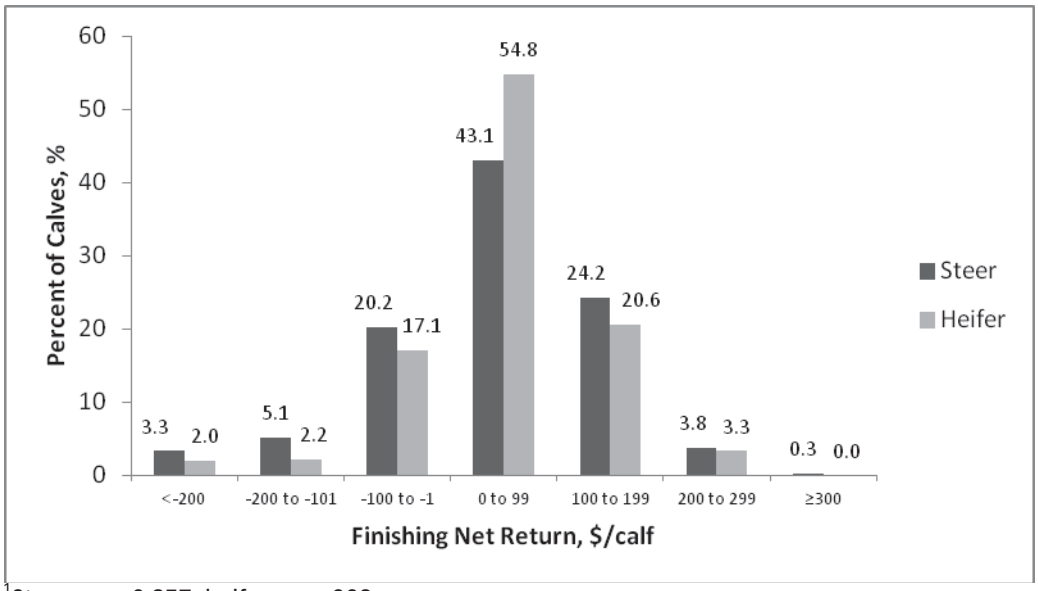
Quality grade distributions for steers and heifers appear in Figure 5. More than 44% of steer carcasses and nearly 55% of heifer carcasses graded USDA Choice or better. In addition, 14.4% of all carcasses graded in the upper two-thirds of the Choice grade, and less than 1% of all carcasses graded Prime.




[1]Steers, n = 5,343; heifers, n = 722.

**Figure 5. Distribution of USDA quality grades for Mississippi Farm to Feedlot Program calves, 1993 to 2005.[1]**

Mean net return from finishing was positive, $31.21 and $42.46, respectively, for both steers and heifers fed through the Mississippi Farm to Feedlot Program during the period studied. Overall mean net return was $32.61 per calf resulting in over $236,700 of total value beyond the farm gate being added to Mississippi calves participating in the program during this time. The distribution of net return from finishing by calf sex is shown in Figure 6. Net return was positive for 71.4% of steers and 78.7% of heifers.




[1]Steers, n = 6,357; heifers, n = 902.

**Figure 6. Distribution of net return from finishing for Mississippi Farm to Feedlot Program calves, 1993 to 2005.[1]**

## Implications

Mississippi Farm to Feedlot Program data provide statewide benchmarks to which individual producers can compare their calves' feedlot performance, carcass merit, and finishing economics. Although the majority of cattle graded Select+ or Choice- for USDA quality grade, there is room for improvement in the percentages of cattle grading average Choice or better. Most calves received USDA yield grades of 2 or 3, and only small percentages graded 4 or 5. Areas in which improvements to record keeping, breeding, nutritional, and health management of calves are needed can be identified using this information.

## Acknowledgments

Appreciation is extended to former Mississippi State University Extension Service Professor and Mississippi Farm to Feedlot Program coordinator, W. B. McKinley, and area livestock agents, K. Brown, C. Covington, R. Higdon, M. Howell, M. Keene, M. Mowdy, L. Newman, L. Stewart, and H. Therrell, for their assistance in data collection.

# Mississippi Farm to Feedlot Program, 2005 to 2011 Summary

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## Extension Summary

The Mississippi Farm to Feedlot Program is coordinated by the Mississippi State University Extension Service. It provides educational information to beef cattle producers on feedlot performance, carcass characteristics, and finishing economics for weaned calves shipped to feedlots from Mississippi. This report summarizes records of steers (n = 1,987) and heifers (n = 764) consigned to the Mississippi Farm to Feedlot Program from 2005 to 2011 and shipped to Iowa feedlots as part of the Tri-County Steer Carcass Futurity. It provides statewide benchmarks that producers can use in comparing their own results to program results.The vast majority of cattle graded Select+ or Choice- for USDA quality grade, but there is room for improvement in the percentages of cattle grading average Choice or better. Most calves received USDA yield grades of 2 or 3, and only small percentages graded 4 or 5. Areas in which improvements to record keeping, breeding, nutritional, and health management of calves are needed can be identified using this information.

## Introduction

The Mississippi Farm to Feedlot Program was established in 1993 to evaluate feedlot and carcass performance for calves produced in Mississippi and to provide educational information to Mississippi beef cattle producers regarding retained ownership as a marketing alternative. It often serves as an introduction to cattle finishing and harvest production and marketing systems for these producers. The program is coordinated by the Mississippi State University Extension Service.

Beef cattle producers consign weaned calves to the Mississippi Farm to Feedlot Program for feedlot shipment. These farms of origin retain ownership of the calves through harvest. Feedlot performance, carcass characteristic, and financial data are collected on individual calves in the program. This information is then shared with the farms of origin on an individual and overall participant basis. Mississippi State University Extension Service personnel assist in data interpretation and make recommendations to individual producers to improve future results. Specifically, recommendations focus on improvements to breeding, genetics, nutrition, and herd health management practices. This report summarizes the results of the Mississippi Farm to Feedlot Program for cattle shipped to Iowa feedlots from 2005 to 2011.

## Procedures

Records of steers (n = 1,987) and heifers (n = 764) consigned to the Mississippi Farm to Feedlot Program from 2005 to 2011 and shipped to Iowa feedlots were used in this analysis. The cattle represented 29 unique farms of origin, 26 feedlot delivery dates, and 30 feeding pens. Cattle from Mississippi operations were shipped to feedlots in Southwest Iowa participating in the Tri-County Steer Carcass Futurity (**TCSCF**) beginning in 2005, with the most recent harvest for this dataset

occurring in May 2011. Seven different TCSCF feedlots were utilized during this time period. Calf shipments to these feedlots occurred during 8 different months, with the majority (61.6%) of calves shipped during the month of June (Figure 1). Late summer, autumn, early winter, and early spring were other key periods of calf shipment activity.

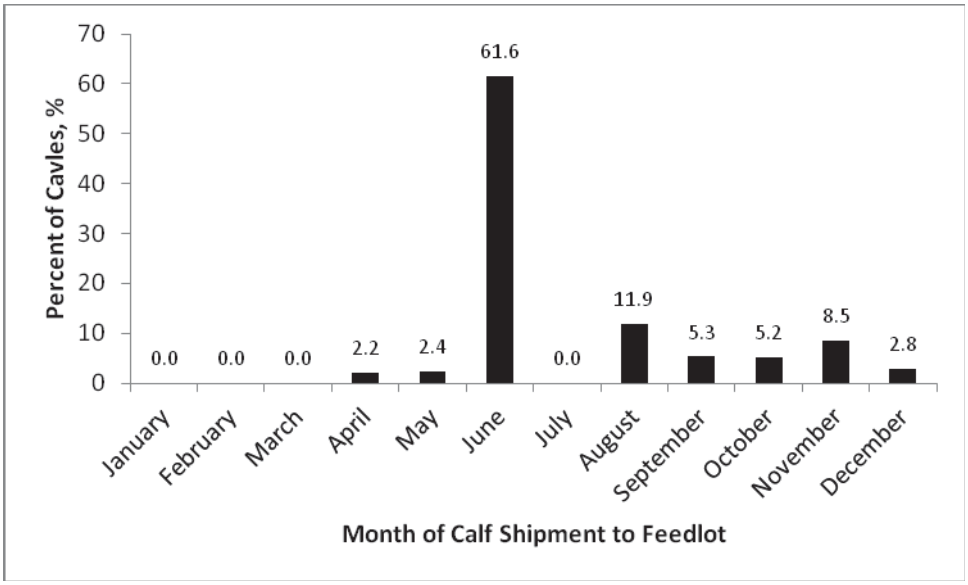



**Figure 1. Distribution of Mississippi Farm to Feedlot Program calf shipments to feedlots by month, 2005 to 2011.**

An on-farm preconditioning period was strongly suggested prior to shipment to the feedlot, but the details of the preconditioning program were left to the owner's discretion. Producers were encouraged to select calves that were representative of their breeding and management programs for enrollment in the Mississippi Farm to Feedlot Program. They were also encouraged to provide information on calf age (individual age or group birth dates), sire and dam identification, and sire and dam breed composition. Appropriate forms were provided to consignors interested in pursuing age verification premiums.

On the day of shipment to the feedlot, calves were weighed and pooled into truckload, 49,000-lb lots at producer farms or Mississippi Agricultural and Forestry Experiment Station sites. Truckload lots and feeding pens represented both single and multiple consignors and both single and mixed calf sex groups (17 steer pens, 5 heifer pens, and 8 mixed sex pens). All calves were weighed within 7 days of arrival, after approximately 35 days on feed (warm-up period), at re-implant time, and within 5 days of harvest. Final body weight was adjusted using overall average daily gain values to the date of harvest. All calves were vaccinated upon arrival, implanted, and offered a starting feedlot diet. A common dietary energy level was used at all 7 feedlots. The implant protocol across all feeding groups typically consisted of an estrogenic implant upon arrival, followed by a combination estrogenic/androgenic implant, and then another combination estrogenic/androgenic terminal implant before harvest.

Cattle were observed daily for morbidity by feedlot personnel. Animals

were removed from home pens when showing clinical signs of respiratory disease, including lethargy, ocular or nasal discharge, or emaciation. Of the cattle removed for clinical signs, those exhibiting rectal temperatures greater than 103.5°F received medical treatment consisting of antimicrobial therapy. Data for mortalities were excluded from all statistical analyses. Morbidity was defined as whether or not calves received medical treatment during the finishing period, and morbidity rates were calculated accordingly.

A disposition score (Beef Improvement Federation 6-Point Scoring System: 1 = docile and 6 = very aggressive) was assigned at on test weighing, re-implant time, and pre-harvest. These disposition scores were averaged to calculate a mean disposition score. The mean disposition score was used (rounded to the nearest integer) to classify calves into three groups for analysis: 1 and 2 = docile, 3 and 4 = nervous, and 5 and 6 = aggressive.

Feed to gain ratio was calculated for each animal using pen level feed disappearance and individual animal body weight gain from the beginning to end of the feeding period and carcass yield grade. The yield grade measurement was used to quantify the percent bone, lean, and fat in the carcass. Using this information, the Cattle Value Discovery System was used to prorate total pen feed consumption across the individual animals based on the amount and composition of gain, lean versus fat. Thus, the resulting feed to gain variable incorporated average daily gain (Perry and Fox, 1997).

Calves were visually evaluated for degree of finish by TCSCF personnel 60 to 80 days after administration of the terminal implant. Animals were determined to be adequately finished when they were visually assessed to have 0.4 to 0.5 inches of backfat. They were then sorted and the cattle determined adequately finished shipped to a commercial abattoir, Tyson Fresh Meats (formerly IBP), Denison, IA. Calves not shipped with the first marketing group were shipped to the abattoir when determined to be adequately finished, typically 28 or more days after the first marketing group.

Upon harvest, detailed carcass data were collected by TCSCF personnel and USDA Graders. Trained TCSCF personnel measured hot carcass weight; back fat thickness; and ribeye area; and estimated kidney, pelvic, and heart fat in the harvest plant on each beef carcass ahead of the grading station. Yield grade was calculated from these carcass measurements. In addition, a USDA grader determined the marbling score, quality grade, and yield grade and based on visual appraisal.

The beginning calf dollar value at feedlot entry was based on cattle weights and the Mississippi USDA weekly feeder cattle summary for the week of shipment to the feedlot. Total cost per animal for finishing was the sum of each calf's feeder animal cost (beginning dollar value at feedlot entry), feed cost, yardage charge, identification tags, animal medical treatments, vaccines, parasite control, implants, trucking to the feedlot, trucking to the abattoir, data collection fee, insurance, and interest. Feed cost was based on feed prices, total body weight gain, and feed to gain ratio. Cattle were marketed on grids paying premiums and discounts based on quality grade and yield grade, and paying discounts on outside of weight range carcasses. Total revenue consisted of sale of each carcass on the value-based grids being utilized by the abattoir at the time of harvest. Net return per animal was the difference

between total revenue and total costs. Simple descriptive statistics are provided in this report.

## Results

Mississippi Farm to Feedlot Program feedlot entry characteristics and performance summary results for calves shipped to Iowa feedlots from 2005 to 2011 are presented in Table 1. Carcass traits are summarized in Table 2. A summary of calf finishing financial performance appears in Table 3.

### Table 1. Mississippi Farm to Feedlot Program feedlot entry characteristics and performance summary, 2005 to 2011

| | Steers | | | | Heifers | | | |
|---|---|---|---|---|---|---|---|---|
| Item | Mean | Minimum | Maximum | Standard Error | Mean | Minimum | Maximum | Standard Error |
| Feedlot entry weight, lb | 759 | 424 | 1,096 | 2.5 | 690 | 372 | 913 | 7.0 |
| Initial value, $/cwt | 92.05 | 68.00 | 132.00 | 0.17 | 83.74 | 64.00 | 120.00 | 0.39 |
| Initial value, $/head | 692.51 | 468.00 | 925.06 | 1.78 | 572.21 | 439.55 | 823.60 | 1.85 |
| Weight at reimplant, lb | 1,018 | 500 | 1,548 | 2.7 | 906 | 556 | 1,314 | 3.5 |
| Final live weight, lb | 1,311 | 780 | 1,735 | 3.3 | 1,178 | 605 | 1,556 | 4.6 |
| Average daily gain, lb/day | 3.66 | 0.96 | 6.16 | 0.02 | 3.31 | 0.50 | 5.34 | 0.03 |
| Feed to gain ratio, lb/lb | 6.42 | 2.76 | 10.91 | 0.02 | 6.63 | 2.51 | 14.57 | 0.05 |
| Days on feed, days | 155 | 76 | 241 | 0.7 | 151 | 89 | 232 | 1.1 |
| Disposition score[1] | 2.02 | 1.00 | 5.30 | 0.02 | 2.29 | 1.00 | 5.50 | 0.03 |
| Individual medical treatments, number | 0.17 | 0 | 5 | 0.01 | 0.14 | 0 | 4 | 0.02 |

[1]Disposition score: Average disposition score based on a 1 to 6 scale, where 1 = docile and 6 = very aggressive.

### Table 2. Mississippi Farm to Feedlot Program carcass trait summary, 2005 to 2011

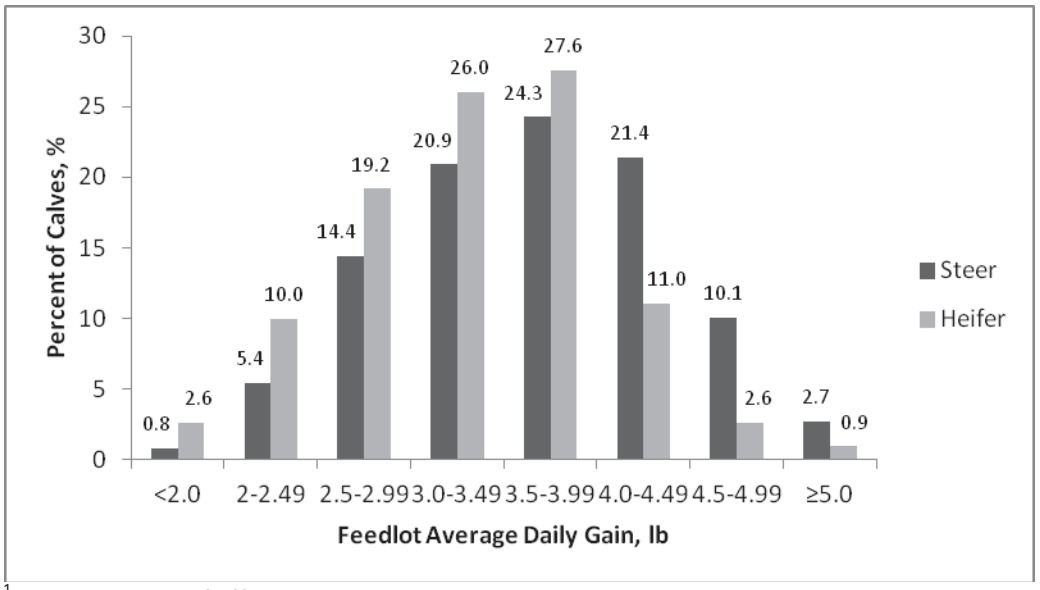
| | Steers | | | | Heifers | | | |
|---|---|---|---|---|---|---|---|---|
| Item | Mean | Minimum | Maximum | Standard Error | Mean | Minimum | Maximum | Standard Error |
| Hot carcass weight, lb | 807 | 529 | 1,041 | 2.1 | 727 | 466 | 955 | 2.7 |
| Dressing percent, % | 61.5 | 54.8 | 69.7 | 0.04 | 61.6 | 54.8 | 68.1 | 0.06 |
| Percent retail product, % | 64.1 | 54.8 | 72.8 | 0.05 | 63.9 | 55.9 | 71.1 | 0.08 |
| Backfat thickness, in | 0.43 | 0.10 | 1.00 | 0.003 | 0.47 | 0.15 | 1.00 | 0.005 |
| KPH fat, % | 2.1 | 1.0 | 3.0 | 0.01 | 2.2 | 1.0 | 3.5 | 0.02 |
| Ribeye area, $in^2$ | 13.1 | 8.2 | 18.4 | 0.03 | 12.5 | 9.8 | 17.1 | 0.05 |
| Ribeye area per cwt, $in^2$/cwt | 1.63 | 1.16 | 2.47 | 0.004 | 1.73 | 1.27 | 2.45 | 0.006 |
| Calculated yield grade | 2.87 | 0.71 | 5.17 | 0.01 | 2.88 | 1.00 | 4.92 | 0.02 |
| USDA yield grade | 2.3 | 1.0 | 5.0 | 0.01 | 2.4 | 1.0 | 4.0 | 0.02 |
| Marbling score[1] | 500 | 350 | 830 | 1.4 | 513 | 380 | 850 | 2.7 |
| USDA quality grade[2] | 18.2 | 15.0 | 22.0 | 0.03 | 18.4 | 15.0 | 22.0 | 0.05 |

[1]Marbling score: Traces = 300-399; Slight = 400-499; Small = 500-599; Modest = 600-699; Moderate = 700-799; Slightly Abundant = 800-899.
[2]USDA quality grade: $Standard^-$ = 15; $Standard^+$ = 16; $Select^-$ = 17; $Select^+$ = 18; $Choice^-$ = 19; $Choice^o$ = 20; $Choice^+$ = 21; $Prime^-$ = 22.

**Table 3. Mississippi Farm to Feedlot Program financial summary, 2005 to 2011**

| | Steers | | | | Heifers | | | |
|---|---|---|---|---|---|---|---|---|
| Item | Mean | Minimum | Maximum | Standard Error | Mean | Minimum | Maximum | Standard Error |
| Trucking cost from MS to IA, $/calf | 45.05 | 23.15 | 82.73 | 0.26 | 37.03 | 22.95 | 62.01 | 0.20 |
| Yardage, $/calf | 50.33 | 3.61 | 78.63 | 0.26 | 46.84 | 6.27 | 78.97 | 0.40 |
| Miscellaneous cost including interest, tags, and insurance, $/calf | 9.30 | 6.86 | 13.90 | 0.04 | 8.66 | 7.47 | 13.62 | 0.06 |
| Vaccine, implant, Optaflexx, and parasite control cost, $/calf | 12.52 | 5.08 | 29.01 | 0.12 | 12.57 | 5.19 | 22.38 | 0.13 |
| Medical treatment cost, $/calf | 4.23 | 0.00 | 159.75 | 0.32 | 3.49 | 0.00 | 122.00 | 0.47 |
| Trucking to abattoir, insurance, and beef checkoff, $/calf | 11.36 | 6.63 | 30.00 | 0.04 | 10.38 | 7.87 | 68.10 | 0.10 |
| Data collection fee, $/head | 8.72 | 0.00 | 10.00 | 0.03 | 8.85 | 0.00 | 10.00 | 0.04 |
| Feed cost, $/calf | 275.57 | 69.38 | 629.56 | 1.50 | 259.84 | 18.59 | 397.14 | 1.68 |
| Feed cost of gain, $/cwt | 50.56 | 24.16 | 97.40 | 0.23 | 53.81 | 34.74 | 124.28 | 0.29 |
| Total cost of gain, $/cwt | 66.91 | 37.89 | 151.82 | 0.29 | 71.21 | 52.96 | 345.61 | 0.54 |
| Net return from finishing, $/calf | 33.91 | -837.59 | 408.07 | 2.66 | 59.22 | -787.25 | 367.63 | 3.60 |

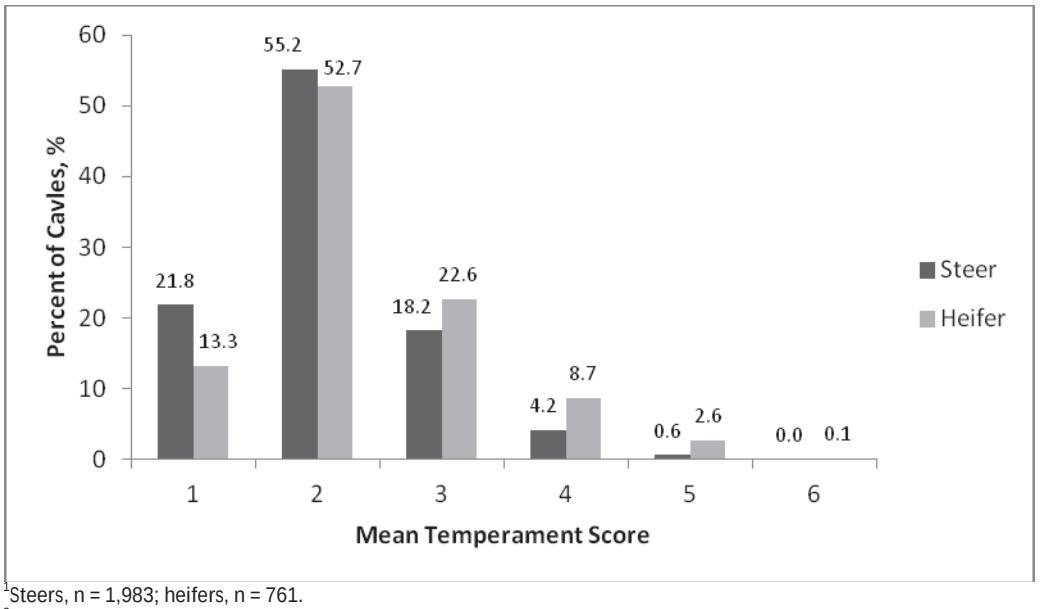
Feedlot average daily gain for individual calves ranged from 0.5 to 6.2 lb per day with an overall average of 3.6 lb per day. Steers averaged 3.7 lb of gain per day, and heifers averaged 3.3 lb of gain per day. The distribution of feedlot average daily gain by calf sex is illustrated in Figure 2. Approximately two-thirds of steers gained between 3.0 and 4.5 lb per day, and more than 7 out of every 10 heifers gained between 2.5 and 4.0 lb per day.




[1]Steers, n = 1,975; heifers, n = 761.

**Figure 2. Distribution of feedlot average daily gains for Mississippi Farm to Feedlot Program calves, 2005 to 2011.[1]**

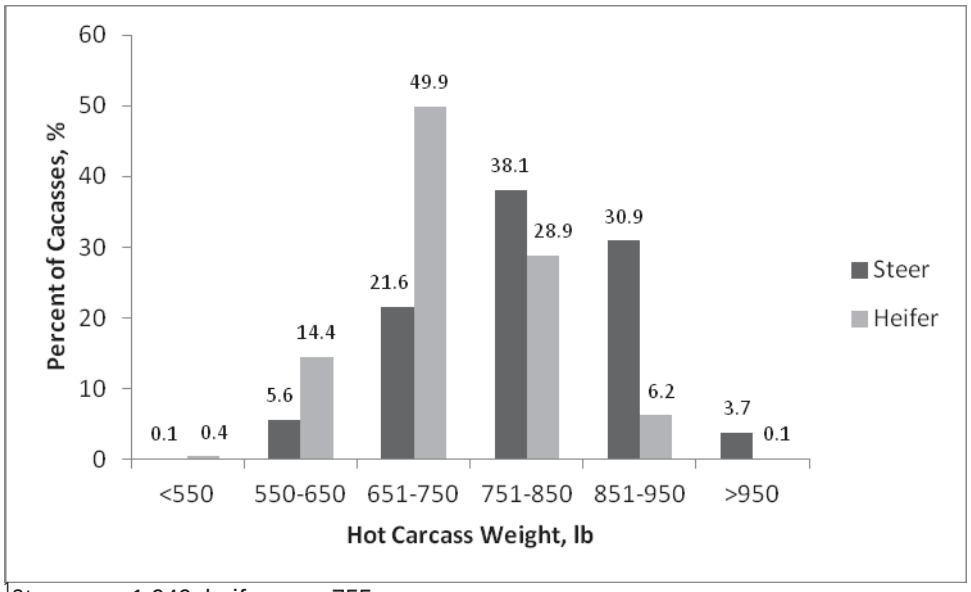
Mean disposition score for individual calves ranged from 1.0 to 5.5 with an overall average of 2.1. Mean disposition scores for steers averaged 2.0, whereas they averaged 2.3 for heifers. Nearly 3 out of every 4 (73.9%) of calves were classified docile (temperament score 1 or 2). Another 24.9% of calves were classified as nervous (temperament score 3 or 4), and only 33 head (1.2%) were classified as aggressive (temperament score 5 or 6). Figure 3 shows the distribution of mean temperament scores by calf sex.




[1]Steers, n = 1,983; heifers, n = 761.
[2]Mean temperament score: 1 = docile, 2 = restless, 3 = nervous, 4 = flighty, 5 = aggressive, 6 = very aggressive.

**Figure 3. Distribution of mean temperament scores for Mississippi Farm to Feedlot Program calves, 2005 to 2011.[1,2]**

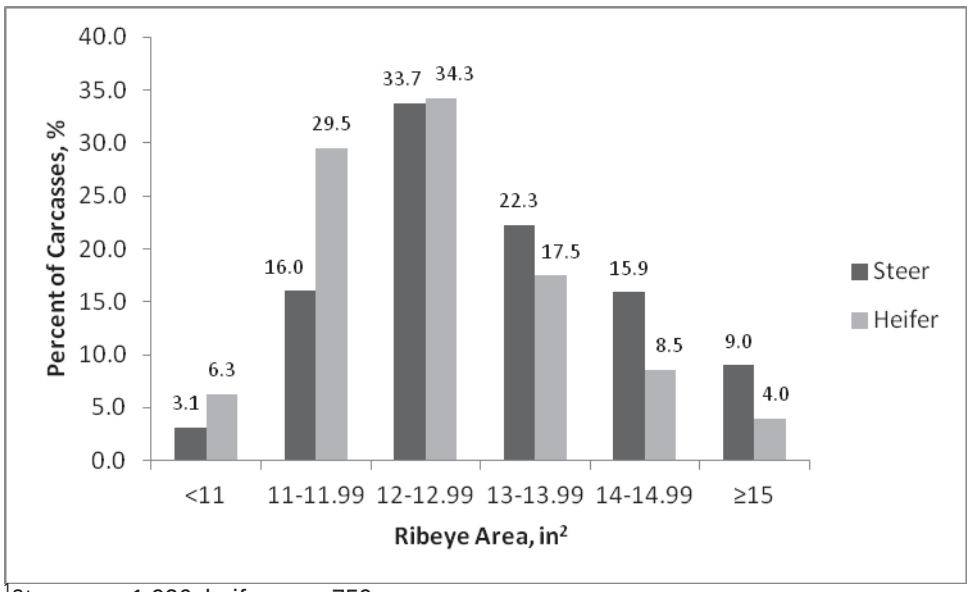
Hot carcass weight discounts were applied to 79 carcasses outside of the accepted 550- to 950-lb range. Less than 0.2% of carcasses were lighter than 550 lb, and only 2.7% of all carcasses were heavier than 950 lb. Hot carcass weight distributions for steers and heifers are shown in Figure 4. Greater than two-thirds of steer carcasses fell within a hot carcass weight range of 751 to 950 lb. Nearly 8 out of 10 heifer carcasses weighed between 651 and 850 lb.




[1]Steers, n = 1,949; heifers, n = 755.

**Figure 4. Distribution of hot carcass weights for Mississippi Farm to Feedlot Program calves, 2005 to 2011.[1]**

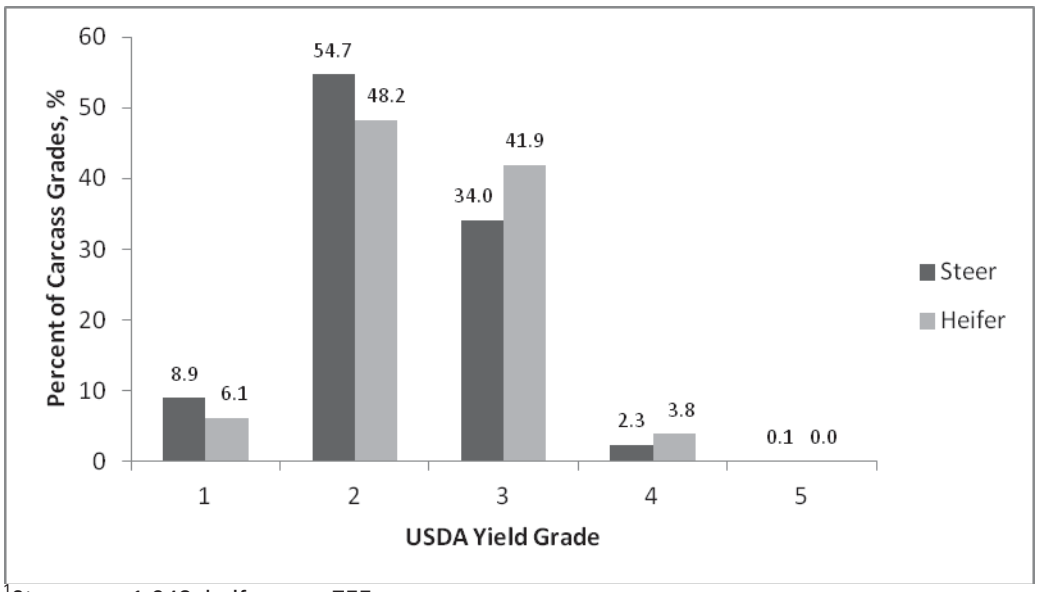
Ribeye area distributions for steers and heifers are shown in Figure 5. The mean ribeye areas for steers and heifers were 13.1 and 12.5 $in^2$, respectively. Just over one-half of both steer and heifer carcasses had ribeye areas between 12 and 14 $in^2$. Only 0.4% of all carcasses had ribeye areas smaller than 10 $in^2$, and only 2.1% had ribeye areas larger than 16 $in^2$.




[1]Steers, n = 1,926; heifers, n = 750.

**Figure 5. Distribution of ribeye areas for Mississippi Farm to Feedlot Program calves, 2005 to 2011.[1]**

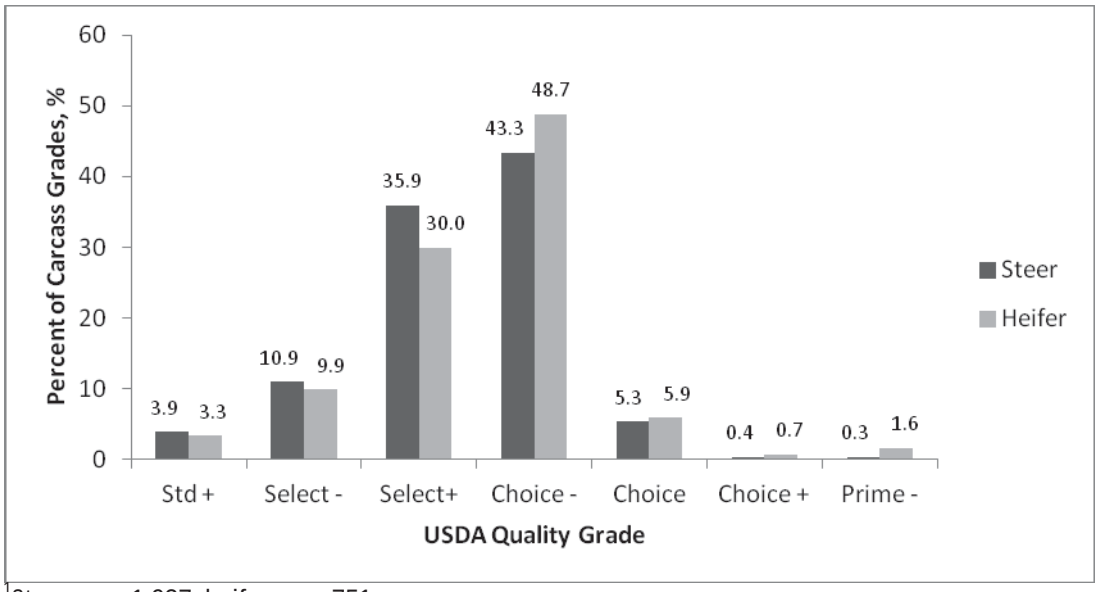
Yield grade distributions for steers and heifers appear in Figure 6. In excess of 63% of steer carcasses were yield grade 1 or 2, and over 54% of heifer carcasses were yield grade 1 or 2. Only 2.4 and 3.8% of steer and heifer carcasses, respectively, were yield grade 4 or 5. The average calculated yield grades were 2.9 for steer and heifer carcasses each.




[1]Steers, n = 1,948; heifers, n = 755.

**Figure 6. Distribution of USDA yield grades for Mississippi Farm to Feedlot Program calves, 2005 to 2011.[1]**

Quality grade distributions for steers and heifers appear in Figure 7. More than 49% of steer carcasses and nearly 57% of heifer carcasses graded USDA Choice or better. However, only 6% of all carcasses graded in the upper two-thirds of the Choice grade, and less than 1% of all carcasses graded Prime.




[1]Steers, n = 1,937; heifers, n = 751.

**Figure 7. Distribution of USDA quality grades for Mississippi Farm to Feedlot Program calves, 2005 to 2011.[1]**

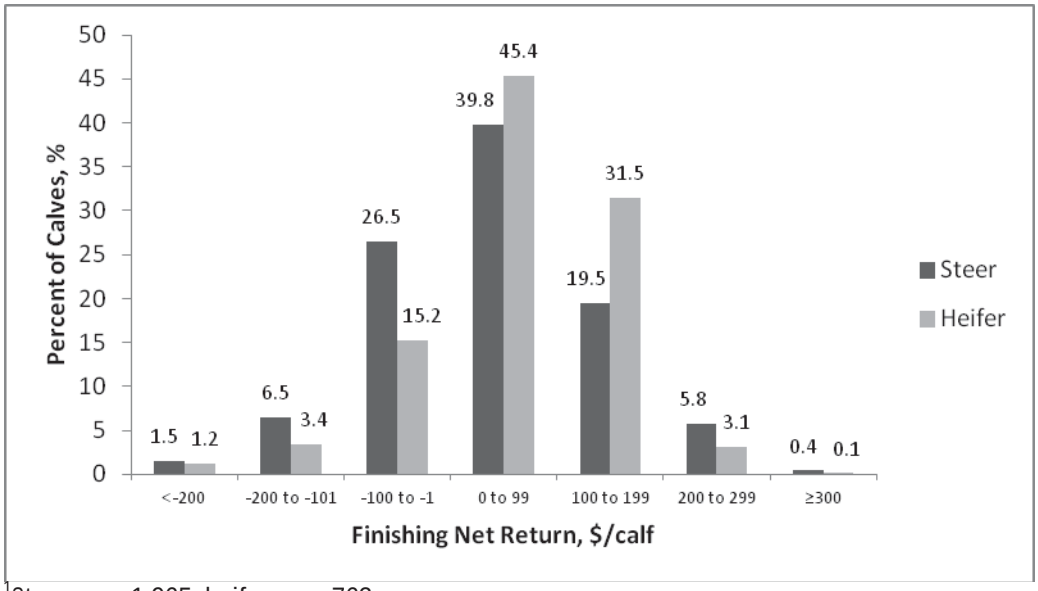
Morbidity rate was 12.6% for steers and 10.2% for heifers. In addition, 24.6% of calves and their carcasses were identified as having at least 1 of the following defects: poor disposition (14.1%), horns (5.4%), lung lesions (2.3%), carcass trim loss (1.9%), rattail (1.6%), bad eye (0.5%), over 30 months of age at harvest (0.5%), dark cutting beef (0.2%), excess sheath (0.1%), and light muscling (0.1%). The average trim loss was 25.4 lb.

Individual birth dates were provided for 860 head or 30.3% of the cattle. Breed of sire and individual sire identification were provided on 251 head (9.1%) and 1,009 head (36.7%), respectively. Age verification premiums ranged from $25.00/head to $35.00/head with an average premium of $32.58/head and 1,120 carcasses or 40.7% of carcasses receiving this premium. The amount of time and effort to maintain and provide the records and paperwork necessary to achieve age verification premiums is more than offset by the potential monetary gains. There is room for improvement in the percentage of Mississippi cattle capturing age verification premiums, and this could be readily achieved in the near future.

Yield grade premiums ranged from $2.00/cwt to $6.50/cwt with an average premium of $2.54/cwt and 1,619 carcasses or 58.9% of carcasses receiving this premium. Certified Angus Beef® premiums ranged from $2.72/cwt to $7.18/cwt with an average premium of $4.09/cwt and 131 carcasses or 4.8% of carcasses receiving this premium. Prime quality grade premiums ranged from $13.48/cwt to $44.35/cwt with an average premium of $18.03/cwt and 17 carcasses or 0.6% of carcasses receiving this premium.

Mean net return from finishing was positive, $33.91 and $59.22, respectively, for both steers and heifers fed through the Mississippi Farm to Feedlot Program during the period studied. Overall mean net return was $40.98 per calf resulting in over $116,800 of total value beyond the farm gate

being added to Mississippi calves participating in the program during this time. The distribution of net return from finishing by calf sex is shown in Figure 8. Net return was positive for 65.5% of steers and 80.2% of heifers.




[1]Steers, n = 1,965; heifers, n = 762.

**Figure 8. Distribution of net return from finishing for Mississippi Farm to Feedlot Program calves, 2005 to 2011.[1]**

## Implications

Mississippi Farm to Feedlot Program data provide statewide benchmarks to which individual producers can compare their calves' feedlot performance, carcass merit, and finishing economics. The vast majority of cattle graded Select+ or Choice- for USDA quality grade, but there is room for improvement in the percentages of cattle grading average Choice or better. Most calves received USDA yield grades of 2 or 3, and only small percentages graded 4 or 5. Areas in which improvements to record keeping, breeding, nutritional, and health management of calves are needed can be identified using this information.

## Acknowledgments

Appreciation is extended to Iowa State University Extension Livestock Specialist, Darrell Busby, and staff with the Tri-County Steer Carcass Futurity for providing feedlot and data collection services.

## Literature Cited

Perry, T. C., and D. G. Fox. 1997. Predicting carcass composition and individual feed requirement in live cattle widely varying in body size. J. Anim. Sci. 75:300-307.

**Physical Units**
°F = Degree Fahrenheit
cal = calorie
Da = dalton
Eq = equivalent
fl oz = fluid ounce
ft = foot(feet)
gal = gal
Hz = hertz
IU = international unit
in = inch(es)
J = joule
lb = pound(s)
lx = lux
*M* = molar (concentration; preferred over mollL)
MPH = miles per hour
mol = mole
N = normal (concentration)
RPM = revolutions per minute
T = ton(s)
V = volt
W = watt
yd = yard(s)

**Units of Time**
s = second(s)
mm = minute(s)
h = hour(s)
d = day(s)
wk = week(s)
mo = month(s)
yr = year(s)

**Statistical Symbols and Abbreviation**
ANOVA = analysis of variance
CV = coefficient of variation
df = degree(s) of freedom
*F* = F-distribution (variance ratio)
LSD = least significant difference
LSM = least squares means
MS = mean square
n = sample size
NS = nonsignificant
*p* = probability
r = simple correlation coefficient
$r^2$ = simple coefficient of determination
R = multiple correlation coefficient
$R^2$ = multiple coefficient of determination
$S^2$ = variance (sample)
SD = standard deviation (sample)
SE = standard error
SED = standard error of the differences of means
SEM = standard error of the mean
SS = sums of squares
*t* = *t*- (or Student) distribution
α = probability of Type I error
β = probability of Type II error
μ = mean (population)
σ = standard deviation (population)
$\sigma^2$ = variance (population)
$\chi^2$ = chi-squared distribution

**Other Abbreviations**
AA = amino acid(s)
ACTH = adrenocorticotropic hormone
ADF = acid detergent fiber
ADFI = average daily feed intake
ADG = average daily gain
ADIN = acid detergent insoluble nitrogen
ADL = acid detergent lignin
ADP = adenosine diphosphate
AI = artificial insemination
AIA = acid insoluble ash
AMP = adenosine monophosphate
AOAC = Association of Official Analytical Chemists International
ARS = Agricultural Research Service
ATP = adenosine triphosphate
ATPase = adenosine triphosphatase
Avg = average
BCS = body condition score
BLUP = best linear unbiased prediction
Bp = base pair
BHBA =β-hydroxybutyrate
BSA = bovine serum albumin
bST = bovine somatotropin
BTA = *Bos taurus* chromosome
BUN = blood urea nitrogen
BW = body weight
cDNA = complementary deoxyribonucleic acid
cRNA = complementary ribonucleic acid
CIEBP = CAAT-enhancer binding protein
cfu = colony-forming unit
CLA = conjugated linoleic acid
CoA = coenzyme A
CN = casein
CNS = coagulase-negative staphylococci
Co-EDTA = cobalt ethylenediaminetetraacetate
CP = crude protein (N x 6.25)
D = dextro
DCAD = dietary cation-anion difference
diam. = diameter
DE = digestible energy
DEAE = (dimethylamino)ethyl (as in DEAEcellulose)
DFD = dark, firm, and dry (meat)
DHI = Dairy Herd Improvement
DHIA = Dairy Herd Improvement Association
DIM =days in milk
DM = dry matter
DMI = dry matter intake
DNA = deoxyribonucleic acid
DNase = deoxyribonuclease
EBV = estimated breeding value
eCG = equine chorionic gonadotropin
EBV = estimated breeding value
ECM = energy-corrected milk
EDTA = ethylenediaminetetraacetic acid
EFA = essential fatty acid
EIA = enzyme immunoassay
ELISA = enzyme-linked immunosorbent assay
EPD = expected progeny difference
ETA = estimated transmitting ability
Eq. = Equation(s)
Exp. = experiment
FCM = fat-corrected milk
FDA = Food and Drug Administration
FFA = free fatty acid(s)
FSH = follicle-stimulating hormone
*G* = gravity
GAPDH = glyceraldehyde 3-phosphate dehydrogenase
GC-MS = gas chromatography-mass spectrometry
GE = gross energy
G:F = gain-to-feed ratio
GLC = gas-liquid chromatography
GLM = general linear model
GnRH = gonadotropin-releasing hormone
GH = growth hormone
GHRH = growth hormone-releasing hormone
$h_2$ =heritability
hCG = human chorionic gonadotropin
HCW = hot carcass weight
HEPES = *N*-(2- hydroxyethyl)piperazine-*N* -2ethanesulfonic acid)
HPLC = high-performance (pressure) liquid chromatogram
HTST = high temperature, short time
i.d. = inside diameter
Ig = immunoglobulin
IGF = insulin-like growth factor
IGFBP = insulin-like growth factor-binding protein(s)
IL = interleukin
IFN = interferon
IMI = intramammary infection
IVDMD = in vitro dry matter disappearance
IVTD = in vitro true digestibility
kb = kilobase(s)
KPH = kidney, pelvic, heart fat
L = levo
LA = lactalbumin
$LD_{50}$ = lethal dose 50%
LG = lactoglobulin
LH = luteinizing hormone
LHRH = luteinizing hormone-releasing hormone
LM = longissimus muscle
LPS = lipopolysaccharide
mAb = monoclonal antibody
mRNA = messenger ribonucleic acid
ME = metabolizable energy
MIC = minimum inhibitory concentration
Misc. = miscellaneous
Monogr. = monograph
MP = metabolizable protein
MUFA = monounsaturated fatty acid
MUN = milk urea nitrogen
NAD = nicotinamide adenine dinucleotide
NADP = nicotinamide adenine dinudeotide phosphate
$NADPH_2$ = reduced nicotinamide adenine dinucleotide phosphate
NADH = reduced form of NAD
NAN = nonammonia nitrogen
NDF = neutral detergent fiber
NDM = nonfat dry milk
NDIN = neutral detergent insoluble nitrogen
NE = net energy
$NE_g$ = net energy for gain
$NE_l$ = net energy for lactation
$NE_m$ = net energy for maintenance
NFC = nonfiber carbohydrates
NEFA = nonesterified fatty acid
No. = number
NPN = nonprotein nitrogen
NRC = National Research Council
NSC = nonstructural carbohydrates
o.d. = outside diameter
OM = organic matter
PAGE = polyacrylamide gel electrophoresis
PBS = phosphate-buffered saline
PCR = polymerase chain reaction
PG = prostaglandin
$PGF_{2\alpha}$ = prostaglandin $F_{2\alpha}$
PMSG = pregnant mare's serum gonadotropin
PMNL = polymorphonuclear neutrophilic leukocyte
PPAR = peroxisome proliferator-activated receptor
PRL = prolactin
PSE = pale, soft, and exudative (meat)
PTA = predicted transmitting ability
PUFA = polyunsaturated fatty acid(s)
QTL = quantitative trait locus (loci)
RDP = rumen-degradable protein
REML = restricted maximal likelihood
RFLP = restriction fragment length polymorphism
RIA = radioimmunoassay
RNA = ribonucleic acid
RNase =ribonuclease
rRNA = ribosomal ribonucleic acid
RQ = respiratory quotient
RUP = rumen-undegradable protein
SCC =somatic cell count
SCM = solids-corrected milk
SCS = somatic cell score
SDS = sodium dodecyl sulfate
SFA = saturated fatty acid
SNF = solids-not-fat
SNP = single nucleotide polymorphism
SPC = standard plate count
ssp. = subspecies
ST = somatotropin
spp. = species
SSC = *Sus scrota* chromosome
TCA = trichloroacetic acid
TDN = total digestible nutrients
TDS = total dissolved solids
TLC = thin layer chromatography
TMR = total mixed ration(s)
Tris = tris(hydroxymethyl)aminomethane
TS = total solids
TSAA = total sulfur amino acids
USDA = U.S. Department of Agriculture
UF = ultrafiltration, ultrafiltered
UHT = ultra-high temperature
UV = ultraviolet
VFA = volatile fatty acid(s)
Vol = volume
vol/vol = volume/volume
vs. = versus
wt = weight
wt/vol = weight/volume
wt/wt = weight/weight