Mississippi State University

Animal and Dairy Sciences

Department Report • 2013

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Division of Agriculture, Forestry, and Veterinary Medicine

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

The Animal and Dairy Sciences Department had a very productive year in 2012/2013. In an effort to better serve the animal agriculture producers of Mississippi the Department has undergone considerable change in personnel and programming. In the last year, we experienced a historical increase in student numbers, an increase in research funding, the addition of new faculty and funding for the new Meat Science and Muscle Biology Research and Education Laboratory that will be located on the main campus near Wise Center. Construction is expected to begin next year with completion in a few more years. Overall, this past year has been very exciting and we hope to continue to grow programs that benefit all producers in Mississippi.

Last year, the Department incurred over $1 million dollars in externally funded research expenditures that resulted in 29 refereed journal publications, 28 presentations at national and international meetings, publication of 10 book chapters and 18 extension reports. I am very proud of the Department's research and extension programs and the economic impact that they have on the state of Mississippi. For your review, we have included several examples of our research and extension activities within this report. We strive to produce research and education programs that are of value to you, our stakeholders; therefore, we look forward to receiving input and guidance from you on the future direction of these programs.

To ensure that our students receive the highest quality education and that we conduct meaningful research, the department welcomed four new faculty members. Dr. Shengfa Liao, a swine nutritionist that brings years of international research experience and much needed expertise to the Department. Dr. Caleb Lemley comes to us following a postdoctoral appointment at North Dakota State University and will strengthen the reproductive physiology emphasis within the Department. Mrs. Jessica Graves is a new instructor with responsibilities for the recruitment and coordination of undergraduate activities. Finally, Mr. Brett Crow joined the Department as an instructor and livestock judging coach. Judging programs are a key component of any Animal and Dairy Sciences Department that wants to have an impact on student education and the industry. Therefore, under the guidance of Mr. Crow, we plan to revitalize the livestock judging programs at Mississippi State.

The Department of Animal and Dairy Sciences appreciates all of the support we have received from you throughout the year and we look forward to future opportunities to serve our industry. Feel free to contact any of us if you have questions or desire additional information. We value your interest and support and welcome you to visit the department anytime.

John Blanton, Jr.
Professor and Head
Animal and Dairy Sciences

INTRODUCTION

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New Faculty in Animal and Dairy Sciences

Dr. John Blanton, Jr. joined the Department of Animal and Dairy Sciences as Professor and Department Head in December 2012. Previously, Dr. Blanton served as the Research Programs Manager for the Agriculture Division of the Samuel R. Noble Foundation. Dr. Blanton received his Bachelor's degree from New Mexico State University in Animal Science before going on to complete his M.S. degree there as well. He completed his Ph.D. in Muscle Growth and Development at Purdue University. After finishing a Post doctoral position at Indiana University Purdue University in Indianapolis, IN., Dr. Blanton took a position as an Assistant Professor at Texas Tech University. Dr. Blanton brings many years of academic and industry experience to his new position as Department Head and is leading the Department in new, exciting directions.

Dr. Caleb Lemley is from a small rural community located near Pentress, West Virginia. His interest in animal physiology started during his undergraduate studies at West Virginia University where he received a B.S. in Biochemistry in 2005. He received a M.S. in 2007 and a Ph.D. in 2010 in Reproductive Physiology under the direction of Dr. Matthew Wilson from West Virginia University. At WVU his research focused on nutritional alterations in progesterone catabolic enzyme activity in the lactating dairy cow. He joined Dr. Kimberly Vonnahme's laboratory at North Dakota State University as a Postdoctoral Research Fellow in 2010. At NDSU his research focused on the effect of dietary melatonin supplementation on uteroplacental blood flow. He joined Mississippi State University in 2012 as an Assistant Professor of Reproductive Physiology. Dr. Lemley's research at MSU focuses on reproductive endocrinology with an emphasis on hormone bioavailability and function during conceptus development. In addition to research, his teaching responsibilities at MSU include Advanced Physiology of Reproduction, Equine Reproduction, and Physiology of Lactation.

Mr. Brett Crow and his wife Karen are both natives of North Alabama. Brett grew up showing and raising livestock and became active in the state's youth livestock judging programs through 4-H and FFA at a very young age. He took his passion for livestock judging to the collegiate level after receiving a scholarship to be a part of the livestock judging team at Butler Community College in El Dorado, Kansas. There, he received an Associate of Science degree in Agriculture in 2005 after two years of competition on the judging team that was either champion or reserve champion at five out of the seven national junior college contests. Brett transferred to Kansas State University where he majored in Animal Sciences and was a member of the 2006 Reserve National Champion livestock judging team. After graduation in 2007, Brett stayed in the Animal Sciences Department at KSU and began working toward a Master's degree in Meat Science while serving as the assistant coach of the livestock judging team, which went on to become the Reserve National Champion team in 2008. After graduation in 2009, he accepted a position as an agriculture instructor and the livestock judging coach at Seward County Community College in Liberal, Kansas. There, he taught animal science courses and coached the judging team. In January of 2013, Brett began his new career as an instructor and livestock judging coach in the Animal and Dairy Sciences Department at Mississippi State University. He teaches courses in livestock

evaluation and livestock management at MSU and is charged with the task of re-establishing a competitive livestock judging team.

Dr. Shengfa Liao joined the Department of Animal and Dairy Sciences as an Assistant Professor in Non-Ruminant Nutrition in August 2012. His academic responsibilities include 50% teaching and 50% research activities. For teaching, Dr. Liao mainly is responsible for instructing Swine Science, Monogastric Nutrition, and Micro-Nutrient Nutrition. For research, his major interest is to understand how dietary nutrients work in concert to promote animal muscle growth.
Dr. Liao earned his DVM/B.S. degree from Anhui Agricultural University (China) in 1984 and his M.S. degree from Nanjing Agricultural University (China) in 1987. He then served as faculty member in the Department of Preventive Veterinary Medicine, Anhui Agricultural University. In 1996 Dr. Liao joined Utah State University as a Research Scientist studying swine model for human cryptosporidiosis. In 2000 Dr. Liao went back to school (University of Alberta, Canada) to pursue his Ph.D. degree in Animal Science/Nutrition and his research was focused on feed additive application to improve swine nutrient utilization. In 2004 he moved to Iowa State University for his postdoctoral research on yeast expression of feed additive proteins using recombinant DNA technology. In 2005 he joined the University of Kentucky to continue his postdoctoral research on molecular animal nutrition/physiology. In 2011 Dr. Liao undertook an Assistant Professor position in Swine Nutrition at Alcorn State University.

Mrs. Jessica Graves, a native of Vance, Alabama, joined the Animal and Dairy Sciences faculty in September 2012 as Undergraduate Coordinator and Instructor. Jessica was exposed to animal agriculture from a very early age on her family's small, commercial beef cattle operation where she assisted with day-to-day management practices. After several years of working alongside a mixed animal practitioner, Jessica's aspirations of becoming a veterinarian grew stronger and stronger. When it came time to choose where she would begin her academic career, there was no hesitation in choosing Mississippi State University's Department of Animal and Dairy Sciences. During her undergraduate career, Jessica was active in student clubs and organizations, where she held various leadership positions. In addition, she participated in the MSU Concert Choir in fulfillment of vocal scholarships. Jessica became interested in the dairy industry during her undergraduate career which lead her to pursue a Master's degree in Agriculture with a concentration in Animal Nutrition, where her thesis focused on evaluating the performance of neonatal Holstein heifers when fed yeast derivatives in milk replacer. Upon joining the Department of Animal and Dairy Sciences as Undergraduate Coordinator, Jessica made implementing a sustainable internship program one of her top priorities. She is very passionate about ensuring students get a well-rounded education and she understands the invaluable experience that many internships offer towards doing just that.

Departmental Scholarships

J. E. Larson and J. M. Graves
Animal and Dairy Sciences, Mississippi State University

Introduction

The Department of Animal and Dairy Sciences has always had the rich tradition of presenting scholarships to a large number of worthy students. Scholarships awarded for the 2013 to 2014 academic year were no exception due to generous alumni and former faculty members. Incoming and current students submitted applications which were reviewed and scholarships were awarded at the Animal and Dairy Sciences' Spring Banquet. Scholarship applicants answered a variety of questions about interests, activities, goals and academic performance. The various scholarships the department offered have a variety of specifications, so the scholarship committee worked hard to match the scholarship with the most deserving student. The majority of scholarships were awarded to current undergraduate students, but several were presented to incoming students and graduate students. Application forms, located on the departmental website, were completed by students and submitted either electronically or by hard copy to the scholarship chairperson by March 15, after that date the scholarship committee, composed of departmental faculty, reviewed and evaluated the applications.

Outcomes

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.

The department awarded over $25,000 in scholarship money to both undergraduate and graduate students. Twenty-four undergraduate scholarships and one graduate scholarship were awarded. The following list is the scholarships awarded and recipients:

- *Bryan and Nona Baker Endowed Scholarship* – Jessica Cowley and Ethan Sutherland
- R*ev. and Mrs. William Page Brown Memorial Scholarship* – Ayla O'Neal
- *Miles Carpenter /Bill McGee-Higgins Endowed Scholarship* – Stephanie Opp
- *Mark Crenshaw Scholarship* – Allison Vidak
- *Billy Gene Diggs Memorial Scholarship* – Jessica Wilson
- *Janice McCool Durff and Alma McCool Liles Scholarship* – Taylor Poe, Alexis Tentler, Emma Stamps, Callie Cornelison, Andrea Seitz, and Destiny Winkler
- *Fuquay Endowed Scholarship* – Caroline Burns
- *Henry H. Leveck Memorial Scholarship* – Liesel Grossner and Taylor King
- *Glenn McCullough Scholarship* – Erin Doll
- *Rodney Moore Scholarship* – Lydia Buckner

- *Enoch Norton Endowed Scholarship* – Keelee McCarty and Courtney Fancher
- *W. L. Buddy Richmond* – Thomas Waldrip
- *Sherry Levin Memorial Scholarship* – Emerald Barrett

MSU Dairy Club 2013 Activities

S. H. Ward
Animal and Dairy Sciences, Mississippi State University

Introduction

The MSU Dairy Club had a very eventful and successful year in 2013. The club participated in several collegiate events and competitions, bringing home honors for MSU at all of them. The MSU Dairy Club is open to all students on campus, but is made up primarily of students from the College of Ag and Life Sciences. In 2012 to 2013, the dairy club had approximately 28 members, which has grown exponentially in the last three years. While the primary goal of the club is to provide students with extra-curricular dairy experiences, the students often participate in collegiate competitions such as North American Intercollegiate Dairy Challenge, at both the southern regional competition and the national competition. In addition, in the fall of 2012, dairy club students halter broke and prepared a show string for the Mississippi State Fair Dairy Open Show and are currently working on breaking a set of heifers for the 2013 Open Show. As a member of dairy club, $5 of the $10 required dues pays for membership in the American Dairy Science Association-Student Affiliate Division. Being a member of this organization, gives student exposure to the dairy industry on a national and international stage. In the spring of 2013, Mississippi State Dairy Club hosted the ADSA-SAD Southern Regional Meeting, where several schools competed in undergraduate paper competitions, quiz bowl, and overall chapter activities events. In the summer of 2013, four of those students traveled to Indianapolis, IN to attend the national American Dairy Science Association meetings and interacted with dairy scientists and industry representatives from across the globe.

Dairy Show String

About 3 weeks prior to the Mississippi State Fair Open Dairy Show, the students picked both heifers and cows from the MSU Bearden Dairy Center population. The more experienced showmen worked with the lactating cows and advised and mentored less experienced students on halter breaking and fitting dairy heifers. Twelve animals in total, 2 cows and 8 heifers were transported to Jackson, MS for the fair.

Kaitlyn Hardin (Senior) and Stephanie Opp (Junior) clip the udder of a Jersey cow for the Mississippi State Fair in 2012

This was a rewarding experience for students in two ways: first, students who had dairy showing experience were able to teach others what they had learned and build lasting relationships with their classmates and second, students who had

never shown livestock before gained a great deal of confidence and pride in their abilities by the time Fair arrived. This was a great team building exercise for the dairy club; they plan to do it again in the fall of 2013.

ADSA-SAD Southern Meeting

At the regional meeting of ADSA-SAD in February 2012, the Mississippi State Dairy Club was nominated to host the 2013 regional meeting. The students worked diligently for months in advance to prepare for students from more than 15 Southeastern universities to arrive in Starkville. The club assembled contest materials, farm and other research center tours, acquired meeting facilities and banquet space and raised over $12,000 to support the meeting.

Outcomes

Dairy Show String

In October of 2012, The MSU Dairy Club took 12 show animals to the Mississippi State Fair. The club members spent many hours during the fall semester halter breaking their heifers and cows and preparing them for show. The students, several who had never shown livestock before, spent at least three hours per week and many weekends preparing their animals. The weekend before the MS State Fair, the students spent time fitting their heifers and cows for show. The students traveled with the animals and cared for them while attending the fair. Several animals placed first in their respective age division (class): Junior Champion Holsteins; Senior Champion Holsteins; and Grand Champion Holstein.

The dairy club with the Bearden Dairy Research Center Manager, Kenneth Graves at the 2012 Mississippi State Fair

At the ADSA-SAD Southern Meeting, the MSU Dairy Club competed in the Quiz Bowl (team pictured below), the scrapbook contest, website contest, submitted a video for the AGvocate contest, which was new at this year's event. The club also had members give presentations in the Dairy Production and Dairy Foods category.

The MSU Dairy Club Quiz Bowl team was Haley Kerr (Senior), Chelsea Meyer (Senior), Rebecca Broome (Junior), and Kaitlyn Hardin (Senior)

The club arranged for tours of the Bearden Dairy Research Center as well as the Wildlife Research Center on the MSU campus. Additionally, all students toured the Leveck Animal Research Center and learned about potential graduate school opportunities at Mississippi State University. At the end of the meeting, the club hosted an awards banquet and dinner

at the Hilton Garden Inn, Starkville, Mississippi.

Students toured the MSU Wildlife Research Facility and learned about research in behavior and management of deer and other non-domesticated species.

In the spring of 2013, the ADSA-SAD Southern Regional meeting over 100 students from the Southeast region to come and learn about the Mississippi dairy industry.

MSU Dairy Club officers at the 2013 ADSA-SAD Awards banquet. From L to R: Haley Kerr (Sr), Kaitlyn Hardin (Sr), Paige Nicholson (Sr), Rebecca Broome (Jr), and Chelsea Meyer (Sr)

National ADSA-SAD

Four dairy club members traveled to Indianapolis, Indiana in July 2013 to attend the Joint Annual Meeting of ADSA and ASAS. While there, students interacted with other collegiate dairy club chapters from all over the nation, toured a large dairy operation in Indiana, attended scientific meetings, and attended the SAD business meetings.

ADS Equine Training Courses: Horses and Students Learning Together

M. C. Nicodemus and R. Campbell
Animal and Dairy Sciences, Mississippi State University

Introduction

Mississippi State University students have the opportunity to work with horses in hands-on laboratories offered through the Department of Animal and Dairy Sciences. There are 9 equine courses offered annually including ADS 1132 Intro to Horsemanship, ADS 2102 Equine Conformation and Performance Evaluation, ADS 2122 Advanced Equine Evaluation, ADS 2212 Equine Behavior & Training, ADS 2312 Advanced Horsemanship, ADS 3223 Horse Management, ADS 3233 Equine Assisted Therapy, ADS 4112/6112 Equine Reproduction, and ADS 4333/6333 Equine Exercise Physiology with 8 out of the 9 courses providing a laboratory component. While most of these laboratories work with adult, trained horses, ADS 2212 Equine Behavior & Training is a laboratory course that allows students to work with untrained weanlings. Other opportunities for the students to work with untrained horses include special topics courses, ADS 4990/6990 Equine Behavior Modification, and directed individual study courses, ADS 4000/6000 Advanced Equine Training. These courses are not offered on a regular basis, but in the past have included laboratories where students were able to saddle break horses that had never been ridden before. During these training courses students are learning alongside the horses as they work with ADS faculty, graduate and undergraduate teaching assistants, Mississippi Agricultural and Forestry Experiment Station (MAFES) Horse Unit staff, and local horse trainers. Students work to prepare their horses for the ADS Annual Equine Production Sale at the end of the fall semester.

ADS 2212 Equine Behavior and Training students working on de-sensitizing the hooves of Golden Arrow Jewel during their laboratory

All training courses have been designed so that students meet multiple days out of the week to work with their assigned horses. All horses used in the training courses are owned by MSU and are housed at the MAFES Horse Unit. Students meet weekly at the MAFES Horse Unit and are assigned multiple horses according to the student's skill level. Students work with ADS faculty, graduate and undergraduate teaching assistants, MAFES Horse Unit Staff, local trainers, and other students enrolled in their respective course.

Students are encouraged to understand the behavior of the equine and to work first to de-sensitize the young horse

to stimuli they may encounter. In ADS 2212 Equine Behavior and Training students work exclusively with newly weaned foals teaching them basic cues of the halter, while the other training courses have been directed towards working with yearlings and 2-year olds getting them started under saddle. Safety and a positive training experience for both the students and the horses are a priority. Although one semester is not enough to make students and horses ready for show, these courses give both horse and student a strong foundation to continue into the show arena.

ADS 4000/6000 Directed Individual Study: Advanced Equine Training student in laboratory working through his first 30 days of saddle training Golden Arrow Jewel

Although some weanlings will be used again in a saddle training course when they are 2-year olds, most weanlings are sold during the annual equine sale along with most yearlings and 2-year olds; and thus, by the end of the semester, students are required to display the progress that they have made with their assigned horses by taking them through the ADS Annual Equine Production Sale. Despite the diverse equine background that the students have when they first enroll in these courses and the limited training that the horses have prior to the course, the expectation for all the horses is to be safe, calm, responsive, and respectful by the time the horses are presented at the sale.

Students are required to assist with the transportation of their assigned horses to the sale facilities, the Mississippi Horse Park in Starkville, Mississippi, and are required to feed and care for their horses while at the facilities. Prior to the sale, students practice moving their horses through the sale arena, either via halter or under saddle, ensuring that the horses are well acquainted to the facilities and are on their best behavior. Students are in charge of the cleaning and grooming of their horses and for exhibiting their horses during the sale. At the end of the sale, they are responsible for assisting the new owners load the horses.

Outcomes

The enrollment of these training courses has reached maximum enrollment each year including this 2013 fall semester, demonstrating the popularity of these courses. While the advanced training courses do not require ADS 2212 Equine Behavior & Training as a prerequisite, 80% of the students taking ADS 4000/6000 Directed Individual Study: Advanced Equine Training this fall semester have taken ADS 2212 during prior fall semesters and the other 20% are taking the two training courses at the same time. The popularity of these courses and the number of students taking multiple training courses suggest an interest in learning more about horse training, particularly because most of the

students enrolled in these courses are taking them as a free elective.

Students in previous semesters were asked to take a voluntary survey at the start and end of their training course. These surveys were focused on measuring student's confidence for performing basic and advanced horse handling and riding activities before and after taking a training course. Results of these surveys have shown a consistent increase in confidence scores after taking a training course. Similar progress was seen in instructors' evaluations of the students and their assigned horses throughout the semester with both horses and students demonstrating a development in horsemanship skills as the semester progressed.

The success of these courses is showcased in the ADS Annual Equine Production Sale. Every year well over 20 horses, primarily weanlings, are sold in the sale with students able to present their horses to the public. Horse breeds presented at the sale have included Quarter Horses, Paint Horses, Thoroughbreds, Arabians, Tennessee Walking Horses, and Trakehners. Average sale price for the horses sold in the 2012 sale was $690.48 per head. Top selling 2012 weanling was Sophisticated Dot and top selling riding horse was Bar Nothin Rondo, both registered with the American Quarter Horse Association and both "graduates" of the MSU training courses. Several of the buyers each year are students of these training courses demonstrating the pride taken by the students for what they have accomplished with their horses.

The 2013 equine sale will be no different in the quality of horses to be showcased with approximately 25 horses to be presented by the students and sold at the Mississippi Horse Park on November 21st. Horses to be sold in the 2013 sale will include mostly weanlings along with some 2-year olds and yearlings that will all be worked with and presented by the students in the fall 2013 training courses.

ADS 2212 Equine Behavior and Training student presenting MSU Fleets Dee Bar at the ADS Annual Equine Production Sale

Even though the training performed in these courses is only the basics to ground handling and/or riding, these activities lay the foundation for success in future training activities for these horses. This is seen in the impressive activities our "horse graduates" have participated in. Events where the MSU "horse graduates" have competed in include, but are not limited to, halter, showmanship, horsemanship, western pleasure, hunter under saddle, gaited pleasure, eventing, team roping, and barrel racing. Their successes in these disciplines are seen at the local, state, and national level. Impressive "graduates" include MSU Fleets Dee Bar, South Mississippi Horse Show and Rodeo Association 2013 High Point Youth Hunter Under Saddle and 2013 High Point (tied) 13-

17 Western Pleasure; Frenchy Tivito, barrel racing money earner; Dun Bar Zipper, Pony of the Year in the United States Eventing Association competitions; MSU Star by Touch, team roping and barrel racing money earner; A Little More Fifty, barrel racing money earner; Golden Arrow Jewel, Palomino Horse Breeders of America (PHBA) National Champion Pleasure Type All Ages Halter Mares; and Golden Arrow Belle, PHBA National Champion Pleasure Type All Ages Color and Senior All Day Pleasure Gait.

Golden Arrow Jewel, "graduate" of the MSU training courses, being shown in Pleasure Type All Ages Halter Mares by Makenna Foster at the Verona PHBA Horse Show (Photo courtesy of Dailey Photography)

Students will have the opportunity during their training laboratories this fall to work under the supervision of ADS faculty Dr. Molly Nicodemus, ADS graduate teaching assistant Ms. Toree Bova, and MAFES Horse Unit staff Mrs. Ryann Campbell and Mrs. Jamie Burkhardt. Although most horses that will be used in these training courses will be offspring of the MSU horse breeding herd, individuals interested in donating to the breeding and/or teaching herd can contact Dr. Nicodemus and/or Mrs. Campbell. Individuals wanting to learn more about future equine sales can contact Mrs. Campbell or can visit the MAFES Horse Unit Facebook page at https://www.facebook.com/pages/Mississippi-State-University-Horse-Unit/230050543736303. Current owners of MSU horses are encouraged to visit the Facebook page and post photos and updates of their horses.

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Mississippi State University Equine Teams: Students Going Beyond the Classroom

M. C. Nicodemus
Animal and Dairy Sciences, Mississippi State University

Introduction

Equine teams including the rodeo, equestrian, and horse judging teams have been an instrumental part of the equine program at Mississippi State University for well over a decade offering students hands-on opportunities outside of the classroom. The rodeo team has a rich history at Mississippi State University being the longest running equine team at MSU, but the relatively younger equestrian and horse judging teams are continuing to make history with their successes. As the first collegiate equestrian team in Mississippi, the MSU equestrian team continued to proudly represent the state starting their competition season in October of 2012 and finishing in February of 2013. The equestrian team consisting of both hunt and stock seat riders traveled throughout the season with 11 members. As the only collegiate horse judging team in Mississippi and of only a few in the Southeast, the MSU horse judging team traveled again this year to American Quarter Horse Worlds where they judged 8 performance classes and 4 halter classes giving oral reasons on 2 of the classes judged. While the rodeo team did not compete this season, the other two teams brought home multiple ribbons making for another successful competition season. The teams are preparing for the next competition season, and are currently recruiting new members.

Mississippi State University offers more than just equine courses as students have an opportunity to be part of an equine team, equestrian, rodeo, and horse judging teams. Although there are other collegiate rodeo and hunt seat equestrian teams besides Mississippi State University in Mississippi, Mississippi State University offers the only collegiate horse judging team and stock seat equestrian team in the state. The equestrian team, both hunt and stock seat teams, is the longest running collegiate equestrian team in Mississippi and was the first to qualify riders to Intercollegiate Horse Show Association (IHSA) Regionals, Zones, and Semi-Finals. The equestrian team has been represented at IHSA Nationals multiple times, and along the way, has won multiple high point rider and team awards at regional shows. This year the team competed in a new IHSA region, Region 2 of Zone 5, which included schools from Mississippi, Georgia, South Carolina, and Alabama. Both the hunt and stock seat teams are coached by Dr. Molly C. Nicodemus, Associate Professor in the Animal and Dairy Sciences department.

Along with Mississippi State University riders having the opportunity to compete on the equestrian team, they also can compete on the rodeo team. The rodeo team has been the longest running equine team at Mississippi State University. Mississippi State University is a part of the Ozark region of the National Intercollegiate Rodeo Association (NIRA) competing

against schools from Mississippi, Missouri, Alabama, Arkansas, Kentucky, and Tennessee. The rodeo team is coached by Mrs. Misty Nabors, coordinator of testing services in the Office of Institutional Research and Effectiveness.

Outside of riding horses, students have the opportunity to judge them at collegiate competitions. The horse judging team is the only collegiate horse judging team to represent Mississippi at collegiate competitions, and the team members have done an excellent job representing both the University and state bringing home multiple national championships. Through Alumni support the team has had the opportunity to represent the state at Grand National and World Championship Morgan Horse Show, American Quarter Horse World Championship Show, U.S. National Arabian and Half-Arabian Championship Horse Show, National Reining Horse Association Futurity and Championship, American Paint Horse Association Intercollegiate Horse Judging Spring Sweepstakes, National Appaloosa Horse Show and World Championship Appaloosa Youth Show, Middle Tennessee State University Intercollegiate Horse Judging Contest, and NACTA Collegiate Horse Judging Contest. Similar to the equestrian team, the horse judging team is coached by Dr. Nicodemus.

Membership for the Teams

Membership on any of the equine teams at Mississippi State University begins by being a full-time student at Mississippi State University. Students do not need to major in a specific department to be on an equine team, but equine scholarships are restricted to Animal and Dairy Sciences majors. At this time, tryouts are not a requirement for any of the teams. Although the experience level is flexible, students should have a strong background in equine and an understanding of the equine competition. Students with limited equine experience can gain the needed experience through equine courses offered through the Animal and Dairy Sciences department. Members will have individual and team practices working with coaching staff and other professionals in the industry.

Rodeo team members are active members of the Rodeo Club, an equine collegiate club at Mississippi State University. Equestrian team members are active members of the Horseman's Association, another equine collegiate club at Mississippi State University. As a member of these clubs, team members will attend meetings and participate in club sponsored events. The Bulldog Classic Spring Quarter Horse Show at the Mississippi Horse Park in Starkville, Mississippi is one of the sponsored events that both clubs have assisted with. Although equestrian team members do not have to own a horse or tack for competition as the University hosting the competition provides both the horse and the tack, rodeo team members need to have a horse, tack, and transportation to compete.

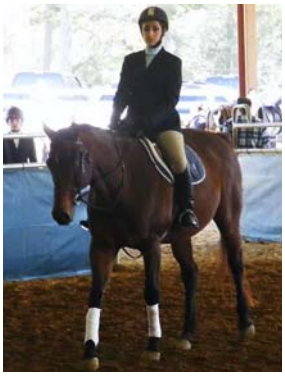
Horse judging team members are not required to be members of a specific equine club. While equestrian team members are encouraged to sign up for University riding courses for practice, horse judging team members are required to enroll in a horse judging course, ADS 2102 Equine Conformation and Performance Evaluation, ADS 2122 Advanced Equine Evaluation, or ADS 4990 Directed Individual Study in Advanced Horse Judging

Techniques. Through the course, team members practice judging various classes that they might see at a horse show. Team members will practice judging videos, University horses, horses from local barns, and horse competing at local shows and will learn how to orally defend their class rankings giving what is called "oral reasons". Prior to heading to competition, team members will participate in a mock horse judging competition hosted by a local horse barn.

Stock seat team members at North Georgia College and State University during their first IHSA horse show of the 2012 to 2013 show season

Process of Competition

Eligibility of a team member to compete on one of the equine teams is determined by the coach and coaching staff. Team members sign up for competitions through their respective coaches. Equestrian team is coached by Dr. Nicodemus and she is assisted by team captains and local trainers. The 2012-2013 Head Captain was Ms. Emerald Barrett and she was assisted by *Captain-In-Training* Ms. Emma Stamps. Local trainers assisting with the coaching of the team for 2012 to 2013 season included Ms. Betsy Ball, Mr. Patrick First, Ms. Brianna Tisdale, and Mrs. Amanda Youngblood. The coach of the Rodeo Team is Mrs. Misty Nabors, and while the team did not compete during the 2012 to 2013 season, team members are encouraged to work with local trainers and professionals along with assisting each other during their practices. Dr. Nicodemus is the coach of the horse judging team and she is assisted by former horse judging team members. The 2012 to 2013 assistant coach for the horse judging team was undergraduate teaching assistant Ms. Brianna Tisdale. Ms. Tisdale is a senior Animal & Dairy Sciences student and former horse judging team member. Graduate students Shannon Lindsey and Toree Bova assisted with team practices and ADS alumni Mrs. Youngblood assisted with the team horse judging clinic hosted at C-Bar Stables.



Elizabeth Wardell, MSU undergraduate student, at the Berry College Hunt Seat IHSA Show riding in her Novice rail class

At this time, MSU does not host a collegiate equine competition so the teams travel to other equine facilities for competition. Competitions are hosted by Universities and/or other equine organizations. Team travel is coordinated under the supervision of the coaches and those that assist the coaches. For all teams, team members need to supply their own competition attire. Those hosting equestrian and horse judging team competitions provide the horses and tack.

Rodeo team competitions require the team members to provide their own horses and tack. For all of the equine teams, team members compete both as individuals and as team members gaining points for both individual and team awards.

Outcomes

Although the rodeo team did not compete during the 2012 to 2013 competition season, both the equestrian and horse judging teams traveled to competitions bringing home multiple top ten honors. Competing for the first time in a new IHSA region, both the hunt and stock seat teams competed at three shows hosted by Berry College and North Georgia College and State University. The team for the first time was represented in the stock seat Alumni Division by MSU graduate student and MSU equestrian team alumni Ms. Leigh Beckman. The team brought home a total of 21 ribbons including one 1st place ribbon, three 2nd place ribbons, four 3rd place ribbons, four 4th place ribbons, five 5th place ribbons, and four 6th place ribbons. The stock seat team was ranked fifth in Region 2 of Zone 5 of the 2012 to 2013 stock seat show season.

As for the horse judging team, they had the opportunity to travel to the American Quarter Horse World Championship Show this past November in Oklahoma City, Oklahoma to compete in their collegiate judging contest. This was the second time since 2001 that the MSU horse judging team has competed at Worlds and was the first time for many of the students to be able to travel to Worlds. AQHA Worlds was the first collegiate horse judging competition for all of the team members making them eligible to compete in the Limited division. The Limited division had a total of 52 entries. The following team members won Top Ten honors: Warren Hillhouse ranking 6th in the Performance division and Chelsey Smith ranking 10th in the Performance division. Lauren Trippe was given Reserve honors placing just out of the Top Ten with a ranking of 11th in the Halter division.

Leigh Beckman, MSU graduate student, representing MSU in the Stock Seat Alumni Division at North Georgia College and State University Stock Seat IHSA Show

Horse judging team at the Collegiate Judging Contest Banquet at the 2013 AQHA World Championship Show

Although the teams brought home multiple ribbons, team participation is more than just a ribbon. Participation on an equine team gives students with no or limited competition experience an opportunity to expand this experience. For some members, these teams are the only opportunity for them to compete. As for

others with more experience, it gives them a different type of opportunity, giving them a chance to compete for the first time as a team member, and not just any team, a collegiate team. Many of the team members have never had the opportunity to travel across state lines, let alone compete in another state. These memories will last a lifetime and it is thanks to all those that donate to these programs with their time, monies, and supplies that these opportunities are possible. Individuals interested in donating to these equine teams can contact Dr. Nicodemus in the Animal and Dairy Sciences department.

The next school year offers new opportunities for MSU students wanting to participate on the equine teams. Rodeo team members are planning to compete this coming year and are actively looking for students wanting to participate. As for the equestrian team, team members will go into their second year competing in the new region and will be headed by their Head Captain Ms. Barrett for her final year before graduating. Ms. Barrett is actively recruiting members wanting to participate in the *Captain-In-Training* program as they train to take over captain duties once Ms. Barrett graduates. New local trainers are also being recruited to assist with team practices. Recent donations to the team offer additional support including horse donations by the Littlejohn family from Longview, Texas and the Holloway family from Brandon, Mississippi to be used in University riding courses; western show clothes donation provided by Ms. Mary Ann Strickland from Kiln, Mississippi; and riding tack donation by local trainer Ms. Betsy Ball of Starkville, Mississippi. In addition to the riding teams, the horse judging team has an exciting year ahead of them as they plan to make the trip to All American Quarter Horse Congress in Columbus, Ohio, the world's largest single-breed show, for the first time in the team's history. For students interested in becoming team members and learning more about equine scholarships contact Dr. Nicodemus.

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Re-establishment of Livestock Judging Team

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Introduction

The MSU livestock judging team will be open to students from any department or college on campus but is already shaping up to be heavily comprised of Animal and Dairy Sciences majors. The livestock judging team is a competitive team that will travel the scope of the U.S. to practices and contests. Students will have the opportunity to attend the country's most prestigious livestock shows and judging contests and visit premier farms and ranches across the country thus developing a network with the nation's leaders in livestock production. Life-long friendships and the ability to work extensively with others are among many skills that come from being a part of a competitive livestock judging team. Students develop the ability to make quick decisions and defend them with logic and also polish their public speaking skills. Clearly, team-members gain an in-depth understanding of the livestock industry and hone skills that prepare them to make a positive impact on its efficiency. However, many of the traits developed through being a part of the team improve their lives on a personal level and serve them well in a variety of occupations.

An "interest meeting" was held in April of 2013 as a way of gathering students who wanted to learn more about the new judging program. The meeting was promoted throughout all departments campus-wide. In this meeting, the coach's expectations of team members regarding time commitments, grades and dedication was discussed along with other generalities about contest and team dynamics for those students less familiar with the way that collegiate judging teams operate. Mr. Crow visited other club meetings within the Animal and Dairy Sciences Department in an effort to promote participation in the new judging program. Throughout the summer of 2013, Mr. Crow traveled to livestock shows throughout Mississippi, Alabama, Georgia and Tennessee promoting the judging program. In a recruiting effort, he also attended the State FFA Livestock Judging Contest in Alabama as well as the State FFA Convention in Mississippi and Mississippi 4-H Club Congress serving as a judge in various contests. Mr. Crow served as an instructor at the 2013 Northwest Georgia Youth Judging Camp as a means of spreading the word about the resurgence of MSU's livestock judging program. He then hosted a youth livestock judging camp in Auburn, AL which gathered participants from all across Alabama and Georgia. Two separate judging camps were hosted on the MSU campus in the summer of 2013 as well. Youth from across Mississippi and Alabama participated in a three-day camp that taught advanced livestock evaluation skills.

Junior 4-H members as well as coaches and volunteers attended a day camp that developed basic judging skills in youth as well as coaching techniques in adult attendees.

MSU 3-day campers at the Leveck Animal Research Center (South Farm, Beef Unit)

The Competition Process

Students interested in being a part of the judging program are eligible regardless of experience level. They are encouraged to enroll in *ADS 4212 Livestock Evaluation* as an introduction to livestock judging and *ADS 4232 Advanced Livestock Evaluation* during the time they are actively participating on the judging team. The upcoming team spends the fall semester attending local practices and determining if they wish to begin the competitive season as a member of the team. Those students who decide to become a part of the group begin traveling to contests during the spring semester and return that Fall to complete their final season of eligibility.

Outcomes

MSU Judging Team Interest

The "interest meeting" was well-attended, and 22 students from several different academic majors have requested to be added to the list of judging team participants. These 22 students represent a broad range of students from freshmen to seniors. If participation interest remains at or near the current level as the spring semester approaches, under-classmen will be encouraged to wait to use their year of eligibility until they approach junior standing. Fall enrollment in *ADS 4212 Livestock Evaluation* has doubled when compared to that of the spring 2013 semester.

Summer Camps

Summer camps were a success. Nineteen participants attended Mr. Crow's judging camp in Auburn, AL. These represented counties from across Alabama and Georgia. Many of the participants have expressed interest in attending MSU. Half of the top-ten high individuals in the 2013 Alabama State 4-H Livestock Judging Contest participated in Mr. Crow's camps. The two camps held on campus were also a major accomplishment.

Students at MSU 3-day camp learn to judge market lambs

Fifty-seven participants from across Mississippi and Alabama were present to learn more about livestock evaluation and get a glimpse of what MSU has to offer. The resurgence of the MSU livestock judging team will be a very important part of adding practical application to many of the concepts taught in the Animal and Dairy Sciences Department. It will serve as a way to promote and develop critical thinking

skills among future industry leaders which is a skill-set that employers have recently identified as being insufficient in graduates first entering the workforce. It will also provide industry networking and professional development that will enhance career opportunities for participants. The steps taken in 2013 have already boosted interest in the livestock judging program among current and future students. Generating an interest among the student body as well as effective recruiting efforts will serve as a vital part of building the MSU livestock judging program.

Swine Science (ADS 4113): Course Update 2013

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Introduction

Swine Science (ADS 4113) is offered annually in the College of Agriculture and Life Sciences at Mississippi State University (MSU). This science-based, 3 semester credit hour course is designed to give students, who are interested in animal science and production, essential classroom instructions and some practical experience in almost all aspects of swine-focused basic biology, production technology, and business management. Undergraduate students, whose major programs are in or are related to the fields of Animal Science, Poultry Science, Meat Science, Veterinary Science/Medicine, as well as Agricultural Business, Management, and Economics, are especially encouraged to enroll. Since the spring of 2013, a newly-hired faculty member, Dr. Shengfa Liao, has been the instructor for this course in the Department of Animal and Dairy Sciences (ADS).

The teaching and learning objectives of this course for the students enrolled include: (1) to develop an understanding of the salient biology of domestic swine, which are similar to the biology of humans in terms of anatomy, physiology, nutrition, and pathology, (2) to develop a comprehension of the technology advancement in the Mississippi, American, and global swine industries, (3) to familiarize students with the proper management practices employed in modern swine operations and their impact on the production profitability, (4) to develop desired skills for making wise decisions in swine operations with knowledge-based principles, and (5) to develop positive attitudes and skills to evaluate and solve those managing and societal issues facing swine operations on a daily basis.

Teaching Components

This course had two major components: classroom lectures and swine husbandry practice. The classroom lectures covered five modules. Module I was an overview of swine industry, Module II covered swine genetics, breeding, and reproduction, Module III was covered swine nutrition, feed, and feeding, Module IV comprehensively covered swine production systems, facilities, and management skills, and Module V discussed swine production economics.

Module I had two chapters: (1) swine domestication and early swine production history and (2) the profile and structure of modern swine industry which covered the US swine industry as well as the global swine industry.

Module II had three chapters: (1) swine breeds, (2) swine genetics and breeding, and (3) swine reproduction. Module III had three chapters as well: (1) swine nutrition, (2) swine feed categories and resources, and (3) how to feed pigs at different life or production stages.

Module IV included six chapters: (1) the environment for pigs, (2) swine production systems and facilities, (3) swine production management, (4) manure management, (5) swine diseases and health management, and (6) the societal issues

that challenge modern swine operations on a daily basis.

Last but not least was Module V, the economics of swine production, in which we discussed: (1) pork composition, quality, and safety, (2) the business aspects of swine production, and (3) how to market different types of pigs for maximizing producers' operational profits.

The husbandry practice component was designed to enhance the course teaching and learning effects by taking the students out of the classroom for a field trip to tour the state-of-the-art "Swine Research and Education Center (SREC)" at Auburn University located in our neighboring state, Alabama. As a small, educational model that reflects modern commercial swine production, this sophisticated SREC (www.ag.auburn.edu/ansc/facilities/swine/index.php) is a farrow-to-finish operation, which encompasses swine husbandry practices along the whole life-cycle of swine, from breeding, gestation, farrowing, lactation, and weaning, all the way to nursery, growing, and finishing stages. The SREC student workers recruited from Auburn University are routinely involved in all aspects of swine operation, from breeding and delivery of baby pigs through feeding and care of market hogs which are bound for processing at the Auburn University Lambert-Powell Meats Laboratory.

This swine husbandry practice component was expected to provide students with not only hands-on experience by working with pigs, but also an excellent opportunity for them to make connections between the theoretical knowledge gained from the classroom lectures and the real-world swine husbandry practices, and this "organic" connection should have a long-term (unforgettable), beneficial impact on the participants who will take future career paths in the animal and food production related fields.

Class Schedule

The class met three times a week (50 minutes each time) in a computer-and-projector equipped classroom during the semester (on Monday, Wednesday, and Friday), which lasted a total of 17 weeks. The instructive lectures were delivered to students during each class period, along with lecture notes and assignments. The field trip took place on a Saturday near the end of the semester.

Achievement Evaluation

The students' achievements were evaluated based on their scores obtained from the pop quizzes, homework assignments, class attendance, and examinations. There were 4 one-hour exams (worth 125 points each and a total of 500 points) and one final exam (worth 500 points). Students earned bonus points from the pop quizzes (worth up to 200 points) and assignments (worth up to 200 points). Twenty-five points were deducted for each unexcused absence; however, the final total deductions were proportionally scaled down for each student with the maximal deduction not exceeding 10% of student's final grade.

A five-letter grading system was used to report students' final course grades, and the breakdown of these grades are: 900 points and above for A ($\geq$ 90%; Excellent), 800 to 899 points for B (80 to 89%; Good), 700 to 799 points for C (70 to 79%; Satisfactory), 600 to 699 points for D (60 to

69%; Poor), and less than 599 points for F (< 60%; Failure).

Outcomes

A total of 45 undergraduate students (7 males; 38 females) were enrolled in this course, of which 22 were juniors, 19 were seniors, 2 were sophomores, and 2 were freshmen. Forty-three students majored in Animal and Dairy Sciences, 1 in Poultry Science, and another 1 in Agricultural Information Science. From a general brief survey, it was found that almost a half of the students planned to pursue their future career in veterinary medicine (pre-vet students), approximately 35% in animal production (including swine, beef, dairy, equine, and poultry production), and the rest in other various fields.

Figure 1. *Students (in purple) were exploring a farrowing room in the Swine Research and Education Center at Auburn University (Auburn, Alabama). Pictured are (from left to right) Anna M. Leach, Kelsey B. Harvey, Amberly Dennis, and Jamie R. Huselton.*

Besides the 42 classroom lectures delivered, the field trip turned out to be a very successful event. Students traveled to Auburn University on a MSU bus, funded by the university. The bus left the MSU campus at 7:00 a.m. and returned to the campus close to 10:00 p.m. on April 13, 2013. During the visit to the SREC at Auburn, students toured not only the interior facility which is defined as a "clean," biosecure area, but also the outside facility which is defined as a "dirty," non-biosecure area. In the biosecure area, students explored the breeding and gestation room, the farrowing room (Figure 1), the nursery room, and finally the growing/finishing room. In the breeding and gestation room, students conducted sow pregnancy detection under the guidance of Mr. Robert Britton (the SREC Director). Following the instructions of Mr. Brian Anderson (the SREC Manager), students learned how to move pigs, weigh pigs, and to detect the backfat thickness of pigs (Figure 2).

In the outside, non-biosecure area, Dr. Frank Owsley, an Extension Animal Scientist & Associate Professor of Auburn University, showed the students how the imported pigs are quarantined, how their feed mill works, how the swine manure is treated, and how the treated manure is applied to their pasture fields.

Figure 2. *Students (in purple) were learning how to move and weigh pigs and how to detect pigs' backfat thickness. Pictured are (from left to right) Taylor A. King and Mary H. Jones.*

After the conclusion of the field trip, students were asked to write a report to summarize what they learned from the trip and how they felt about the practice. Almost all of them expressed their great appreciation for the opportunity and said they learned a lot from the trip. The last sentence of Ms. Tinadre Harris (a junior student) read: "We all learned a lot and it was great to be able to visually see everything that we had discussed in lecture." "It was an experience that I will never forget!" said Ms. Jamie Huselton (a sophomore student).

Implications

Pork, one of the most economical sources of animal protein for human consumption, is the most consumed meat in the world, as pigs grow fast and offer more meat per breeding female than any other livestock species (Adesehinwa et al., 2010). Thanks to the great advantages in the technology and the cost of swine production, as well as the consumer acceptance of the pork product in terms of the product safety and quality, the United States will continue to be the world's largest pork exporter for years to come (FAO, 2009; 2012). Professional courses concerning swine biology, production, health, and management in the undergraduate curricula of the US land-grant universities will remain or increase their importance in undergraduate education. It is expected that the teaching and learning effect of Swine Science (ADS 4113) at MSU will continue to be improved.

Acknowledgements

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Evaluation of Methods of Temperament Scoring for Beef Cattle

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Research Summary

Temperament can negatively affect various production traits, including live weight, ADG, DMI, conception rates and carcass weight (Fordyce et al., 1985; 1988; Burrow and Dillon, 1997; Petherick et al., 2003). The objective of this research study was to evaluate temperament scoring methods in beef cattle. Crossbred (n = 228) calves were evaluated for temperament at weaning by an individual observer who used two scoring methods: 1) pen score (1 to 5 scale, with higher scores indicating increasing degree of nervousness, aggressiveness, etc; groups of three animals) and 2) exit velocity (m/s; rate an animal traverses 1.83 m after exiting a cattle squeeze chute). Temperament score was the average of pen score and exit velocity. These same calves were re-evaluated for temperament with two different methods of pen scoring one week later: 1) individual pen score (1 to 5 scale) and 2) group pen score (1 to 5 scale; groups of three animals, same as weaning measure). Data were analyzed using the mixed linear models with sire as a random effect. Age and sire breed of calf did not ($P > 0.05$) affect temperament measurements; however sex of calf did influence group and individual pen score measurements ($P < 0.05$) and tended ($P = 0.08$) to influence weaning pen score. Heifers had greater pen scores compared to bulls and steers when scored as a group and greater than bulls when scored as individuals and at weaning. Pen scores in groups were highly correlated ($P < 0.0001$) with individual pen scores, weaning pen score, weaning exit velocity, and weaning temperament score. In summary, 1) heifer calves have greater pen scores compared to bulls or steers; 2) temperament score did not differ between group and individual pen scoring methods; and 3) results from these methods were highly correlated with each other and the results derived from other established methods of temperament scoring.

Introduction

Many factors can adversely affect the growth and productivity of livestock. These include stressors associated with management practices, such as weaning, handling relative to transportation, and vaccination, which can modulate growth through the production of stress-related hormones (e.g., cortisol, epinephrine, and norepinephrine; Crookshank et al, 1979; Rulofson et al., 1988; Lay et al., 1992; Carrasco and Van de Kar, 2003; Charmandari et al., 2005; Buckham Sporer et al., 2008). As the cost of cattle production continues to increase, it is essential for producers to find ways to decrease input cost to potentially increase profit. Temperament is an additional factor that can influence the productivity of cattle.

Temperament is defined as the manner in which cattle react to humans or novel environments (Fordyce et al., 1988). Various methods are used to measure temperament, with the two most commonly used by our laboratories being pen score and exit velocity (see Burdick et al., 2011 for review). Pen score is a subjective method to measure temperament. For the measurement, cattle are separated in groups of 3 to 5 animals and their reactivity to a human observer is ranked on a scale of 1 to 5 (Hammond et al., 1996). Exit velocity, is also referred to as flight speed, and has emerged as a more objective measurement of temperament in cattle (Fell et al., 1999; Curley et al., 2006; Müller and Von Keyserlingk, 2006; Vann et al., 2008). Exit velocity (Curley et al., 2006; Burrow et al., 1988) is defined as the rate (in meters/second) at which an animal traverses a specified distance after exiting a squeeze chute. As different aspects of behavior may be evaluated by different systems for measuring it (Curley et al., 2006), we calculate an average of pen score and exit velocity to create a temperament score. Based on temperament score, cattle can be ranked into temperament groups (e.g. calm, intermediate, and temperamental). A recent study has reported the heritability of pen score (0.44), exit velocity (0.28), and temperament score (0.41) in Brahman cattle (Loyd et al., 2011). Previous research has demonstrated that temperament can negatively affect various production traits, including live weight, ADG, DMI, conception rates, milk yield, carcass weight, tenderness, rib fat, and bruise score (Hafez and Lindsay, 1965; Fordyce et al., 1985; Fordyce et al., 1988; Burrow and Dillon, 1997; Breuer et al., 2000; Petherick et al., 2003; Prayaga and Henshall, 2005; King et al., 2006; Müller and von Keyserkingk, 2006; Hoppe et al., 2010; Café et al., 2011). Critics of temperament measurement procedures advocate that as chute scoring and exit velocity are measured on cattle individually, pen score should be performed in the same manner in order to compare it with other temperament measurements. However, there is a concern that, as cattle are gregarious animals, temperamental cattle may display extreme behaviors when scored in a pen alone rather than with other cattle.

Procedures

Crossbred (n = 228) calves were evaluated for temperament by an individual observer at weaning by two methods of scoring: 1) pen score (1 to 5 scale, with higher scores indicating increasing degree of nervousness, aggressiveness, etc.; recorded in groups of 3 animals) and 2) exit velocity (the rate in m/s for an animal to traverse 1.83 m after exiting a squeeze chute). Temperament score was calculated as the average of pen score and exit velocity. In addition, these same calves were re-evaluated for temperament with two methods of pen score one week later: 1) individual pen score (1 to 5 scale) and 2) group pen score (1 to 5 scale; recorded in groups of 3 animals, same as weaning measure). Cow age group was evaluated and defined as 2 = 2-year old; 3 = 3-year old; 4 = 4-year old; 5 = 5- to 10-year old; 6 = >10-year old cows. Data were analyzed using mixed linear models with sire as a random effect.

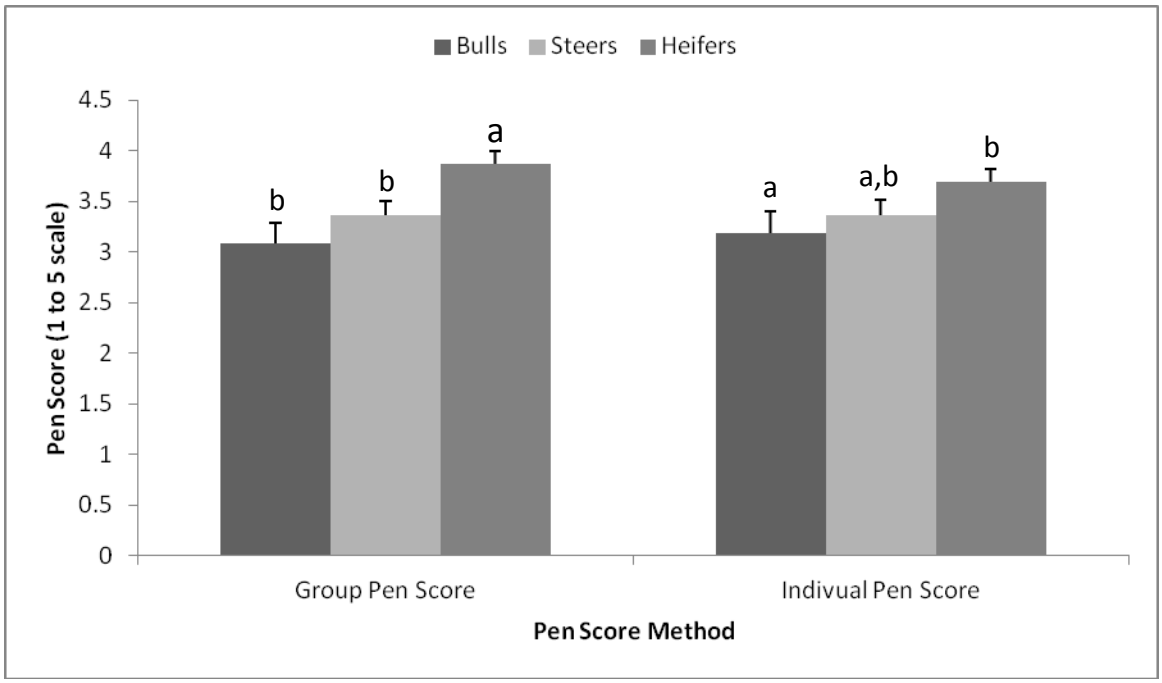

Figure 1. Means and standard errors for group and individual pen score measurements for bulls, steers and heifers. Pen score as a group ($P < 0.007$); Pen score as individual ($P < 0.05$).

Results

This study was designed to evaluate the method of pen temperament scoring (individual versus group) and association with other methods of temperament scoring. Weaning age and sire breed of calf did not ($P > 0.05$) affect temperament measurements; however, sex of calf did influence group and individual pen score measurements ($P < 0.05$) and tended ($P = 0.08$) to influence weaning pen score measurement. Heifers had greater pen score measurements (Figure 1) compared to bulls and steers when scored as a group (3.87 ± 0.12 vs 3.08 ± 0.21 and 3.36 ± 0.14, respectively). At weaning and when scored as individuals, heifers had greater pen scores than bulls but was not different from steers (3.69 ± 0.13 vs 3.19 ± 0.21 and 3.37 ± 0.14, respectively). Pen scores in groups were highly correlated ($P < 0.0001$) with individual pen score (r = 0.81); weaning pen score (r = 0.62), weaning exit velocity (r = 0.54) and weaning temperament score (r = 0.67). For residual correlation coefficients, pen scores in groups were highly correlated ($P < 0.0001$) with individual pen score (r = 0.79); weaning pen score (r = 0.61), weaning exit velocity (r = 0.55) and weaning temperament score (r = 0.66). Cow age group influenced group pen score, individual pen score, weaning exit velocity and weaning temperament score ($P < 0.02$). In this research herd, three-year-old cows had calves with the greatest group pen scores, individual pen scores, and weaning temperament scores. Cows greater than five years of age followed next with the two year-old cows having calves with the lowest temperament scores when scored either as individuals or in a group (Figure 2). In summary, 1) female calves have greater pen scores compared to male calves; 2) temperament score did not differ between group and individual pen scoring methods;

and 3) results from these methods were highly correlated with each other and with results derived from other established methods of temperament scoring.

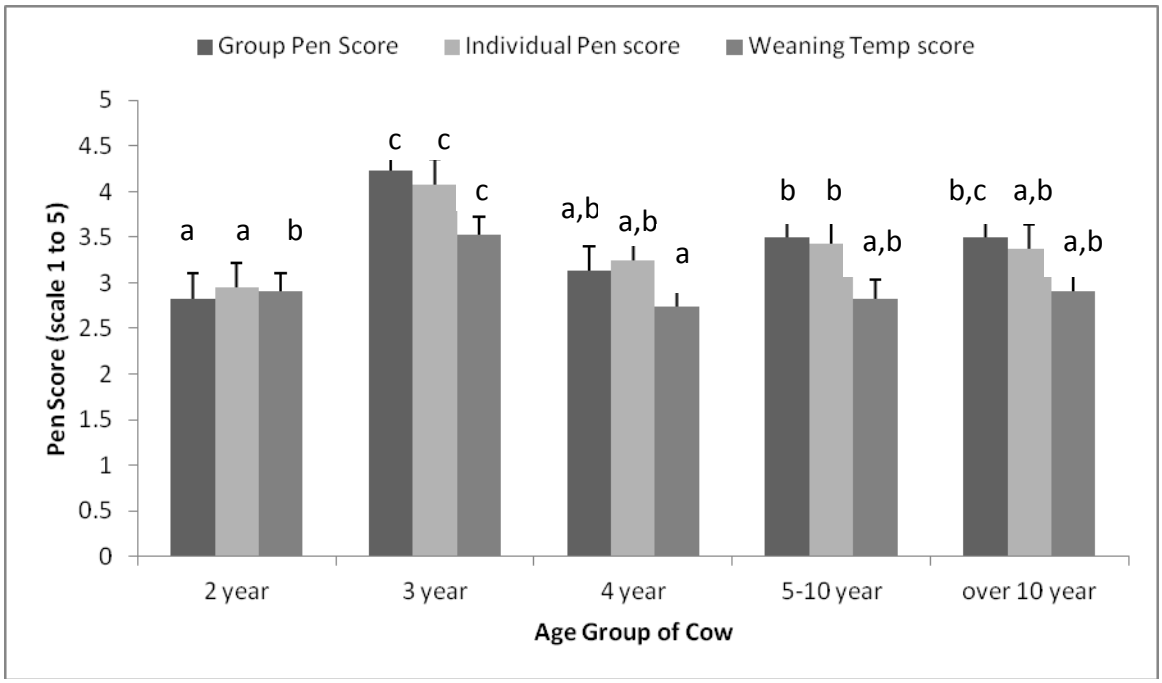

Figure 2. Means and standard errors for the group pen score (P = 0.002), individual pen score (P = 0.005) and weaning temperament score (P = 0.017) for different age groups of cows (2 = 2-year old; 3 = 3-year old; 4 = 4-year old; 5 = 5-to 10-year old; and 6 = >10-years old).

Implications

Differences in temperament exist between male and female calves independent of the method of temperament scoring utilized. Regardless of whether calves were scored by a group pen score method or an individual pen scoring method the results were comparable. The methods of temperament scoring used in this research project were highly correlated with each other as well as with results from other methods of temperament scoring used in the industry.

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Maternal Nutrient Restriction Followed by Realimentation during Early to Mid-gestation on Liver Steroid Inactivation in Beef Cows

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Research Summary

The objective was to determine the effect of early to mid-gestation maternal nutrient restriction followed by realimentation on liver steroid inactivation. On day 30 of gestation, cows were assigned to dietary treatments: control (C; 100% NRC; n = 18) and restricted (R; 60% NRC; n = 30). On day 85 cows were slaughtered (C, n = 6 and R, n = 6), remained on control (CC; n = 12) and restricted (RR; n = 12), or were realimented to control (RC; n =11). On d 140 cows were slaughtered (CC, n = 6; RR, n = 6; RC, n = 5), remained on control (CCC, n = 6; RCC, n = 5), or were realimented to control (RRC, n = 6). On day 254 all remaining cows were slaughtered. Jugular blood samples were collected prior to slaughter for steroid analysis. At slaughter maternal liver samples were collected for hepatic enzyme activity analysis. The enzymes measured in this study are proportional to the level of progesterone P4) clearance within the liver. Therefore, increased concentration of these enzymes will result in decreased concentrations of P4. Cytochrome P450 2C (CYP2C) activity decreased ($P < 0.09$) in R vs. C. Cytochrome P450 3A (CYP3A) activity decreased ($P < 0.09$) on day 254 of gestation vs. day 85 and 140. Uridine diphosphate-glucuronosyltransferase (UGT) activity was increased ($P = 0.05$) in R vs. C and decreased ($P < 0.05$) in RR vs. RC and CC. Concentrations of estradiol-17β (E2) increased ($P < 0.01$) as gestation proceeded. On day 85 E2 concentrations were increased ($P < 0.05$) in R vs. C. On d 140 P4 concentrations were increased ($P < 0.05$) in RR vs. RC and CC. The current study highlights the importance of steroid inactivation in modulating peripheral concentrations of E2 and P4 during gestation.

Introduction

Progesterone is required for the maintenance of pregnancy as it blocks uterine contractions from occurring (Csapo, 1956). In ruminants, a decrease in pregnancy rates may be due to decreased concentrations of P4. It is important to note that both production from the corpus luteum and/or liver inactivation impacts peripheral concentrations of P4. Rhinehart et al. (2009) examined the relationship between luteal P4 secretion and liver clearance in lactating dairy cattle, which showed that liver inactivation of P4 contributed a major role in modulating peripheral P4 concentrations. Therefore, additional characterization of these liver enzymes throughout gestation will allow researchers to design therapeutic supplements to modify steroid clearance during critical windows of pregnancy.

Cattle with an elevated dry matter intake have increased blood flow to the digestive tract and liver. This in turn leads

to an increased delivery rate of steroids to the liver and thus increased metabolism of these substrates (Wiltbank et al., 2006). Excessive steroid inactivation contributes to decreased peripheral concentrations, which can alter reproductive performance. Two potential changes that occur during mid to late gestation are decreased placental nutrient exchange due to decreased concentrations of P4 (Fowden et al., 2006) and decreased uterine blood flow due to decreased concentrations of E2 (Ford, 1995). Both of these responses during fetal growth of the calf can have dramatic consequences to the growth and welfare of the offspring in later life.

Steroids are highly lipophilic and therefore difficult for animals to excrete through the urine and feces. However, several liver enzymes contribute to steroid inactivation by adding polar groups to the molecule. This makes the molecule more hydrophilic and thus easily excreted in the urine and feces. These enzymes include cytochrome P450 1A (CYP1A), 2C (CYP2C), 3A (CYP3A), aldo-keto reductase 1C (AKR1C), and uridine diphosphate-glucuronosyltransferase (UGT; Lemley and Wilson, 2010). Currently, these enzymes have not been characterized throughout gestation and little is known about how liver enzyme function may contribute to reproductive performance. Therefore, our primary objective was to characterize liver steroid inactivating enzymes throughout gestation. We also examined the effect of maternal nutrient restriction followed by realimentation on liver steroid inactivating enzymes.

Procedures

A total of 54 non-lactating, multiparous crossbred beef cows (initial BW = 1,368 ± 25 lbs, BCS = 5.1 ± 0.1) of similar genetic background were synchronized using a Select Synch plus P4 insert (CIDR; Pfizer Animal Health, New York, NY) and fixed-time AI protocol. At the NDSU Beef Research and Teaching Unit (Fargo, ND), cows were assigned to 1 of 6 breeding groups with breeding dates ranging from July 13 to October 24, 2011. Artificial insemination was performed utilizing the AM/PM rule approximately 12 hours after the first detected estrus. Inseminated cows were then transported to the Animal Nutrition and Physiology Center (ANPC; Fargo, ND) within 3 days post-insemination. From arrival at ANPC until confirmed pregnant, cows were grouped in pens (n = 4 to 5/pen) and trained to use the Calan gate feeding system. On days 27 and 28 post-insemination, pregnancy was confirmed via transrectal ultrasonography (500-SSV; Aloka, Tokyo, Japan). On day 30 of gestation, cows were randomly assigned to dietary treatments (Figure 1): control (C; 100% NRC; n = 18) and nutrient restriction (R; 60% NRC; n = 30). On d 85 cows were slaughtered (C, n = 6 and R, n = 6), remained on control (CC; n = 12) and restricted (RR; n = 12) treatments, or were realimented to control (RC; n = 11). On d 140 cows were slaughtered (CC, n = 6; RR, n = 6; RC, n = 5), remained on control (CCC, n = 6; RCC, n = 5), or were realimented to control (RRC, n = 6). On day 254 all remaining cows were slaughtered (CCC, n = 6; RCC, n = 5; RRC, n = 6). Jugular blood samples were collected prior to slaughter for steroid analysis. At slaughter maternal liver samples were collected, weighed, and

snap frozen for hepatic enzyme activity analysis.

The control diet consisted of chopped grass/legume hay [8.0% CP, 69.2% NDF, 41.5% ADF, and 57.9% TDN (DM basis); containing predominately cool season grasses with small amounts of alfalfa] to meet NE recommendations for maintenance and fetal growth (NRC, 2000). Nutrient restricted cows received 60% of the same control hay diet. Cows were individually fed once daily in a Calan gate system at 10 a.m. and had free access to water.

Liver samples collected at slaughter were analyzed for protein concentration and assayed for hepatic enzymes Cytochrome P450 1A, 2C, 3A, and UGT. Serum concentrations of E2 and P4 were measured via radioimmunoassay (Siemens Healthcare Diagnostics, Los Angeles, CA).

The MIXED procedure of SAS (SAS Inst. Inc., Cary, NC) was used to test the effect of gestational day within the control groups and the effect of maternal nutrition within a given gestational day. Data found to be non-normally distributed were tested using the Wilcoxon rank sum test. Treatment means were separated using the PDIFF options of the LSMEANS statement. Least square means and SE are reported. Statistical significance was declared at $P < 0.10$.

Results

Gestational day effects for all dependent variables are illustrated in Table 1. Activity of CYP1A, CYP2C, AKR1C, and UGT were not different across gestational day when expressed relative to mg of liver protein ($P > 0.30$) or total liver enzyme activity ($P \geq 0.20$). Activity of CYP3A decreased ($P < 0.09$) on day 254 of gestation vs. 85 and 140. Concentrations of E2 increased ($P < 0.01$) as gestation proceeded. Concentrations of P4 were not different across gestational day ($P = 0.10$).

Nutritional plane effects for all dependent variables within gestational day 85, 140, and 254 are illustrated in Table 2, Table 3, and Table 4, respectively. Activity of CYP1A was not affected ($P > 0.10$) by maternal nutrient restriction on days 85, 140, or 254 of gestation. Activity of CYP2C was decreased ($P = 0.04$) by maternal nutrient restriction in the R vs. C group at day 85 of gestation when expressed as total liver CYP2C activity. However, there was no effect ($P > 0.10$) of maternal dietary treatment on total liver CYP2C activity on day 140 or 254 of gestation. Activity of CYP2C was not affected ($P > 0.40$) by maternal dietary treatment on day 85, 140 or 254 when expressed as mg of liver protein.

Activity of CYP3A was not affected by maternal dietary treatment on days 85, 140, or 254 of gestation when expressed as mg of liver protein ($P > 0.20$) or as total liver CYP3A activity ($P > 0.60$). Activity of AKR1C was not affected by maternal dietary treatment on days 85, 140, or 254 of gestation when expressed as mg of liver protein ($P > 0.10$) or as total liver AKR1C activity ($P > 0.40$). Activity of UGT was increased ($P = 0.04$) in the R vs. C group at day 85 of gestation when expressed as mg of liver protein; however, this effect was absent ($P > 0.10$) when expressed as total liver UGT activity. Activity of UGT was decreased in the RR group vs. CC and RC at d 140 of gestation when expressed as mg of

liver protein (P = 0.04) and total liver UGT activity (P = 0.02). Activity of UGT was not affected by maternal dietary treatment on day 254 of gestation when expressed as mg of liver protein (P = 0.99) or total liver UGT activity (P = 0.47). Concentrations of E2 were increased (P = 0.03) in the R vs. C group at day 85 of gestation. There was no affect (P > 0.60) of maternal dietary treatment on concentrations of E2 at d 140 and 254 of gestation. Concentrations of P4 were increased (P = 0.01) in the RR group vs. the CC and RC groups at day 140 of gestation. There was no effect (P > 0.80) of maternal dietary treatment on concentrations of P4 at day 85 or 254 of gestation.

Table 1. CYP1A, CYP2C, CYP3A, AKR1C, UGT, E2, and P4 concentrations at day (d) 85, 140, and 254 in control cows receiving 100% NRC recommendation for maintenance and fetal growth (C, CC, and CCC groups).[1]

Dependent Variable[2]	d 85	d 140	d 254	SE	*P*-values
CYP1A					
RLU/min/mg of protein×10^3	452.4	641.3	256.0	198.7	0.33
Total activity RLU/min×10^9	183.8	143.4	97.6	32.2	0.20
CYP2C					
RLU/min/mg of protein	2,074.0	2,762.0	1,794.0	797.0	0.64
Total activity RLU/min×10^6	829.7	642.9	663.3	96.2	0.34
CYP3A					
RLU/min/mg of protein×10^3	606.2[a]	642.5[a]	207.2[b]	189.1	0.09
Total activity RLU/min×10^9	240.4[a]	174.1[a]	76.0[b]	54.9	0.09
AKR1C					
RLU/min/mg of protein	66.1	121.0	69.8	29.7	0.80
Total activity RLU/min×10^6	26.4	2.9	26.4	2.3	0.34
UGT					
RLU/min/mg of protein×10^6	3.8	8.2	4.3	2.1	0.70
Total activity RLU/min×10^9	1,493.0	1,952. 0	1,628.0	237.5	0.35
E2, pg/mL	18.4[a]	44.0[b]	110.7[c]	8.8	< 0.01
P4, ng/mL	7.2	4.9	8.6	1.1	0.10

[1]CYP1A = cytochrome P450 1A; CYP2C = cytochrome P450 2C; CYP3A = cytochrome P450 3A; AKR1C = aldo-keto reductase 1C; UGT = uridine diphosphate-glucuronosyltransferase; E2 = estradiol 17-β; P4 = progesterone.
[2]Enzyme activity expressed relative to mg of liver protein and as total enzyme activity in the liver, which is calculated as enzyme activity per gram multiplied by maternal liver weight.
[a,b,c]Least square means with different letter superscripts depict differences P < 0.10.

Table 2. CYP1A, CYP2C, CYP3A, AKR1C, UGT, E2 and P4 concentrations in C and R cows at day 85 of gestation.[1]

Dependent Variable[2]	C	R	SE	*P*-values
CYP1A				
RLU/min/mg of protein×10^3	452.4	374.7	81.5	0.51
Total activity RLU/min×10^9	183.8	105.5	27.92	0.11
CYP2C				
RLU/min/mg of protein	2,074.0	2,097.0	312.0	0.95
Total activity RLU/min×10^6	829.7[a]	593.1[b]	73.8	0.04
CYP3A				
RLU/min/mg of protein×10^3	606.2	567.9	160.2	0.28
Total activity RLU/min×10^9	240.4	200.9	71.6	0.70
AKR1C				
RLU/min/mg of protein	66.1	85.7	9.1	0.16
Total activity RLU/min×10^6	26.4	24.9	1.3	0.40
UGT				
RLU/min/mg of protein×10^3	3,760.9[a]	6,817.7[b]	920.8	0.04
Total activity RLU/min×10^9	1,493.0	1,929.0	186.7	0.13
E2, pg/mL	18.4[a]	26.3[b]	2.3	0.03
P4, ng/mL	7.2	7.2	1.3	0.98

[1]CYP1A = cytochrome P450 1A; CYP2C = cytochrome P450 2C; CYP3A = cytochrome P450 3A; AKR1C = aldo-keto reductase 1C; UGT = uridine diphosphate-glucuronosyltransferase; E2 = estradiol 17-β; P4 = progesterone.
[2]Enzyme activity expressed relative to mg of liver protein and as total enzyme activity in the liver, which is calculated as enzyme activity per gram multiplied by maternal liver weight.
[a,b]Least square means with different letter superscripts depict differences $P < 0.10$.

Table 3. CYP1A, CYP2C, CYP3A, AKR1C, UGT, E2 and P4 concentrations in CC and RC and RR cows at day 140 of gestation.[1]

Dependent Variable[2]	CC	RC	RR	SE	*P*-values
CYP1A					
RLU/min/mg of protein×10^3	641.3	336.0	216.8	206.7	0.38
Total activity RLU/min×10^9	143.4	93.1	84.6	24.9	0.23
CYP2C					
RLU/min/mg of protein	2,762.0	1,995.0	1,598.0	789.0	0.48
Total activity RLU/min×10^6	642.9	589.4	618.4	68.6	0.87
CYP3A					
RLU/min/mg of protein×10^3	642.5	508.3	391.5	149.1	0.51
Total activity RLU/min×10^9	174.1	147.4	147.1	28.0	0.75
AKR1C					
RLU/min/mg of protein	121.0	93.8	67.8	34.0	0.14
Total activity RLU/min×10^6	29.1	26.4	26.1	1.7	0.41
UGT					
RLU/min/mg of protein×10^6	8,186.9[a]	5,165.6[a]	3,355.6[b]	179.7	0.04
Total activity RLU/min×10^9	1,952.0[a]	1,612.0[a]	1,296.0[b]	88.3	0.02
E2, pg/mL	44.0	48.6	52.6	6.4	0.60
P4, ng/mL	5.0[a]	4.7[a]	6.8[b]	0.49	0.01

[1]CYP1A = cytochrome P450 1A; CYP2C = cytochrome P450 2C; CYP3A = cytochrome P450 3A; AKR1C = aldo-keto reductase 1C; UGT = uridine diphosphate-glucuronosyltransferase; E2 = estradiol 17-β; P4 = progesterone.
[2]Enzyme activity expressed relative to mg of liver protein and as total enzyme activity in the liver, which is calculated as enzyme activity per gram multiplied by maternal liver weight.
[a,b]Least square means with different letter superscripts depict differences $P < 0.10$.

Table 4. CYP1A, CYP2C, CYP3A, AKR1C, UGT, E2 and P4 concentrations in CCC and RCC and RRC cows at d 254 of gestation.[1]

Dependent Variable[2]	CCC	RCC	RRC	SE	*P*-values
CYP1A					
RLU/min/mg of protein×10^3	256.0	241.8	242.1	66.6	0.98
Total activity RLU/min×10^9	97.6	65.0	104.1	23.6	0.51
CYP2C					
RLU/min/mg of protein	1,794.0	1,692.0	2,000.0	321.0	0.80
Total activity RLU/min×10^6	663.3	530.5	863.6	105.0	0.13
CYP3A					
RLU/min/mg of protein×10^3	207.2	389.6	262.5	87.0	0.58
Total activity RLU/min×10^9	76.0	110.0	108.0	26.6	0.62
AKR1C					
RLU/min/mg of protein	69.8	58.8	52.0	7.4	0.21
Total activity RLU/min×10^6	26.4	19.1	22.2	3.8	0.92
UGT					
RLU/min/mg of protein×10^3	4,317.6	4,196.1	4,253.3	692.4	0.99
Total activity RLU/min×10^9	1,628.0	1,343.0	1,801.0	267.7	0.47
E2, pg/mL	110.7	117.7	100.3	16.0	0.72
P4, ng/mL	8.6	7.8	8.4	0.96	0.83

[1]CYP1A = cytochrome P450 1A; CYP2C = cytochrome P450 2C; CYP3A = cytochrome P450 3A; AKR1C = aldo-keto reductase 1C; UGT = uridine diphosphate-glucuronosyltransferase; E2 = estradiol 17-β; P4 = progesterone.
[2]Enzyme activity expressed relative to mg of liver protein and as total enzyme activity in the liver, which is calculated as enzyme activity per gram multiplied by maternal liver weight.
[a,b,c]Least square means with different letter superscripts depict differences $P < 0.10$.

Activity of CYP3A was not affected by maternal dietary treatment on days 85, 140, or 254 of gestation when expressed as mg of liver protein ($P > 0.20$) or as total liver CYP3A activity ($P > 0.60$). Activity of AKR1C was not affected by maternal dietary treatment on days 85, 140, or 254 of gestation when expressed as mg of liver protein ($P > 0.10$) or as total liver AKR1C activity ($P > 0.40$). Activity of UGT was increased ($P = 0.04$) in the R vs. C group at day 85 of gestation when expressed as mg of liver protein; however, this effect was absent ($P > 0.10$) when expressed as total liver UGT activity. Activity of UGT was decreased in the RR group vs. CC and RC at d 140 of gestation when expressed as mg of liver protein ($P = 0.04$) and total liver UGT activity ($P = 0.02$). Activity of UGT was not affected by maternal dietary treatment on d 254 of gestation when expressed as mg of liver protein ($P = 0.99$) or total liver UGT activity ($P = 0.47$). Concentrations of E2 were increased ($P = 0.03$) in the R vs. C group at day 85 of gestation. There was no affect ($P > 0.60$) of maternal dietary treatment on concentrations of E2 at d 140 and 254 of gestation. Concentrations of P4 were increased ($P = 0.01$) in the RR group vs. the CC and RC groups at d 140 of gestation. There was no effect ($P > 0.80$) of maternal dietary treatment on concentrations of P4 at day 85 or 254 of gestation.

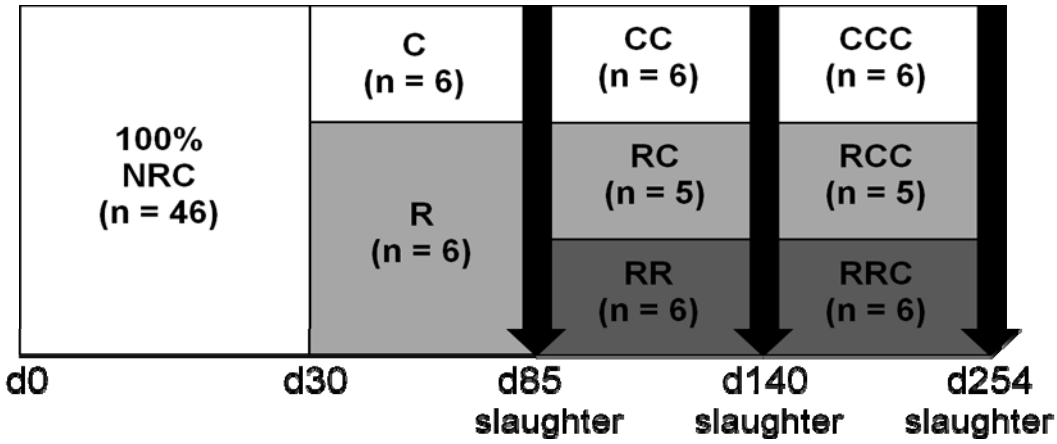

Figure 1. Experimental design consisted of training 46 beef cows to the Calan gate feeding system from day 0 to 30 of gestation. On day 30 cows were randomly assigned to one of two dietary treatments: control (C; 100% NRC; n = 18) and nutrient restriction (R; 60% NRC; n= 30). On day 85 cows were slaughtered (C, n = 6 and R, n = 6), remained on control (CC; n = 12) and restricted (RR; n = 12) treatments, or were realimented to control (RC; n =11). On day 140 cows were slaughtered (CC, n = 6; RR, n = 6; RC, n = 5), remained on control (CCC, n = 6; RCC, n = 5), or were realimented to control (RRC, n = 6). On day 254 all remaining cows were slaughtered (CCC, n = 6; RCC, n = 5; RRC, n = 6).

Implications

Concomitant changes occurred in Cytochrome P450 3A activity and peripheral concentrations of estradiol 17-β, while the increase in progesterone concentrations on day 140 was accompanied by a decrease in liver uridine diphosphate-glucuronosyltransferase activity in the RR group. Further characterization of these enzymes during gestation will allow researchers to design specific therapeutic supplements to negate excessive steroid inactivation during gestation. Modifying the clearance rate of progesterone or estradiol 17-β could lead to an increase in placental nutrient transfer capacity and/or uterine blood flow during specific time points of gestation.

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Correlations among Nutritional Status of the Dairy Cow during Early Gestation and Subsequent Growth and Cardiac Measurements of Her Offspring

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Research Summary

The potential of calves to become productive cows may be related to characteristics of growth and cardiac function early in life. The objective of this experiment was to determine whether nutritional status of the dam and milk production during early gestation, was correlated with measurements of the calf at birth and at 1 mo of age. From parturition until 90 days pregnant, blood samples were collected every 14 days in Holstein cows. Plasma was later assayed for concentrations of glucose and β-hydroxybutyrate (BHBA) to indicate the nutritional status of cows. Calves (n = 26) born from these cows were measured for blood pressure, heart girth, hip and wither height as well as carotid artery hemodynamics measured via Doppler ultrasonography [pulsatility index (PI) and resistance index (RI)]. Mean arterial pressure (MAP) as well as other values were then calculated to assess the cardiac health of the calf. The CORR procedures of SAS were used to analyze data; means (± SD) are presented. In calves at birth, mean milk production of dams during early gestation was positively correlated ($P < 0.05$) with heart girth. As expected, length of gestation was also positively correlated ($P < 0.05$) with heart girth of calves at birth and at 1 mo of age. Mean concentration of glucose in dams was positively ($P < 0.05$) correlated with wither height in calves at 1 month of age. Length of gestation was negatively ($P < 0.01$) correlated with RI in calves at 1 month of age. Milk production in the dam was positively correlated ($P < 0.10$) with hip and wither height, and PI but negatively correlated with MAP in 1-month old calves. These correlations lead to speculation that early gestational environment may impact growth and hemodynamic parameters in young calves.

Introduction

Growth characteristics and cardiac function in a young calf may affect health and production characteristics later in life. Previous research indicates the importance of maternal diet and nutrient availability to the health and viability of her offspring. The energy density of the diet pre-partum can impact neonate weight, size, and immune function (Gao, 2012). Maternal nutritional and endocrine characteristics influence the growth of the placenta and fetus, from as early as a few days after fertilization. Negative influences on the placenta impact fetal development and subsequent offspring development (Robinson, 1995). Maternal nutrition can alter blood flow to the uterus, changing nutrient availability to the fetus via the placenta (Vonnahme and Lemley, 2012). Blood flow is an important indicator of cardiac health and nutrient availability to particular tissues.
Large, healthy calves are more likely to become productive, long-term members of the lactating herd. Therefore, the first

objective of this experiment was to determine whether the nutritional status of the dam during early gestation was correlated with growth, development, and hemodynamics of her offspring. The second objective was to determine if measurements collected from calves at birth and at 1 month of age were correlated.

Procedures

All procedures in this study were approved by the Institutional Animal Care and Use Committee of Mississippi State University.

Cows

Initially, 135 Holstein cows from the Mississippi State University Bearden Dairy Research Center were evaluated from an estimated 3 weeks prior to calving until 90 days post-conception. Cows were housed in 2 free-stall barns with access to water *ad libitum* and were fed twice daily a total mixed ration formulated to meet or exceed dietary requirements of dry or lactating cows (NRC, 2001). All cows were subjected to a strict 60-day voluntary waiting period and then artificially inseminated after detected in standing estrus or as a timed AI after synchronization of ovulation, per normal herd procedures. Cows were inseminated with frozen thawed semen by trained technicians. Due to negative effects of heat stress in Mississippi during summer months, this herd was managed with a seasonal breeding season with no females being inseminated from the end of May to mid-November. Therefore, cows were evaluated between September, 2011 and August, 2012. Pregnancy diagnosis was performed by palpation per rectum on approximately day 32 post-AI by a herd veterinarian and confirmed between days 60 and 90.

Beginning an estimated 3 weeks prior to calving and every 14 days after until 90 days in gestation, cows were assessed for BCS (Edmonson et al., 1989) by one of two trained observers. Subsequent to calving, blood samples were collected every 14 days. After collection, samples were placed on ice until returned to the laboratory where serum was collected and frozen until analysis. Due to a variation in days open for individual cows, the number of blood samples collected ranged from 9 to 19.

Milk production was recorded daily in the parlor via Westfalia Surge Milk Meters. For analysis, milk production was averaged between two consecutive milkings at four time points (date of AI and 30, 60, and 90 days post-AI) during the first trimester of pregnancy.

Calves

Twenty-six singleton calves (16 female, 10 male) born from these dams were evaluated at birth and at 1 month of age (August, 2012 to February, 2013). Calves were weighed at birth. Within 2 days of birth, calves were measured for size characteristics (crown to rump length, heart girth, hip and wither height) and a blood sample was collected from the jugular vein.

Blood pressure (systolic and diastolic pressures) and heart rate were evaluated using a blood pressure cuff while the calf was lying down. From these measurements, mean arterial pressure (MAP; diastolic + [0.33333*(systolic-diastolic)]) and pulse pressure (systolic-diastolic) were calculated to assess the pressure in the artery and

during a pulse. Hemodynamic characteristics of the carotid artery were evaluated using Doppler ultrasonography which detects blood flow. Resistance index (RI), which is an indicator of the resistance the blood encounters as it travels through the artery, and pulsatility index (PI), which is an indicator of resistance downstream. Resistance downstream may occur, for example, if the vessel constricts or branches. The area of the carotid artery was also evaluated to calculate the total amount of blood that flows through the artery. To take these measurements, the probe of the ultrasound was placed on the skin directly over the carotid artery (Figure 1). From these measurements, mean blood velocity (s – d)/PI) and blood flow (mean blood velocity * cross sectional area of vessel * 60 sec) were calculated.

All measurements (size, blood pressure, hemodynamics) were recorded again when the calf was 1 month (± 4 days) of age.

Figure 1. Ultrasound measurements recorded from a calf.

Analysis of Serum

Serum samples from cows and calves were analyzed for concentrations of glucose. The greater the glucose in the blood serum, the more is available to the gestating fetus or for the calf's growth and development. Serum from cows was analyzed for concentrations of β-hydroxybutyrate (BHBA). β-hydroxybutyrate is detected in blood serum when fat is being metabolized for energy, in other words, the cow is not consuming enough energy to meet her needs and she is in a negative energy balance. So the more BHBA in the blood, the lower is her nutritional status.

Statistical Analyses

Pearson correlation coefficients were derived using the CORR procedure of SAS (SAS). Means ± SD are presented and correlations were considered significant when $P \leq 0.05$ and a tendency when $P > 0.05$ but ≤ 0.10.

Results

Table 1 consists of averages of all parameters measured in the calves at both birth and at one month of age. Although these data are presented to characterize the calves, it does make sense that size characteristics increase from birth to one month of age and that heart rate declines but arterial and pulse pressure increase. This also is consistent with blood velocity and blood flow increasing from birth to one month of age. In a statistical analysis, the growth traits (Table 1) were positively correlated between birth and one month of age while all other parameters were not.

Table 1. Measurements of calves at birth and one month of age (mean ± SD)

	Measurements of calves	
Parameter	At birth	At 1 month of age
Glucose	4.2 ± 1.05 mmol/L	4.2 ± 0.51 mmol/L
Heart girth*	30.3 ± 1.74 in	34.1 ± 2.06 in
Hip height*	31.3 ± 1.61 in	33.6 ± 1.53 in
Wither height*	30.0 ± 1.71 in	32.6 ± 1.61 in
Mean heart rate	129.5 ± 21.26 bpm	110.2 ± 26.47 bpm
Mean arterial pressure	80.1 ± 8.76 mmHg	95.3 ± 16.58 mmHg
Pulse pressure	42.8 ± 6.98 mmHg	49.2 ± 9.52 mmHg
Mean resistance index	0.8 ± 0.15	0.8 ± 0.13
Mean pulsatility index	2.4 ±1.26	2.4 ± 1.02
Mean blood velocity	41.8 ± 15.18 cm/sec	46.3 ± 15.93 cm/sec
Mean blood flow	395.5 ± 202.15 mL/min	431.5 ± 172.87 mL/min

*Parameters positively correlated ($P < 0.001$) between birth and one month of age.

Table 2 consists of averages of all parameters measured in cows that had calves included in the study. The average milk yield across the four time points (time of AI, 30, 60, and 90 days after conception) was 89 lb of milk. There was a fairly high standard deviation and that is because the range for days in milk at the time of conception was 43 to 167 days. The range in this calculated mean was 46 to 119 lb among cows. The concentration of BHBA (Table 2) was also variable, no doubt due to the range in days in milk which is tied to energy balance.

Table 2. Measurements of dams during early gestation (mean ± SD)

Mean milk yield	89.1 ± 18.3 lb
Mean concentration of glucose	3.5 ± 0.65 mmol/L
Mean concentration of β-hydroxybutyrate	905.3 ± 505.17 µmol/L
Gestation length	279.7 ± 3.84 days

Tables 3 and 4 contain r values indicating the correlation between two variables. The r value can range between -1 and 1, with a negative value indicating a negative relationship (one variable increases while the other decreases) and a positive value indicating a positive correlation (both variables increase). A *P*-value is tied to these r values; when the *P*-value is < 0.05 it is considered statistically

significant and if it is between 0.05 and 0.10 it has a tendency to be significant. Any value greater that 0.10 is not considered to be correlated.

Table 3. Pearson correlations (r) between growth and cardiovascular measurements in calves at birth and in dams during early gestation

Measurements at birth in calves	Measurements in dams during early gestation			
	Mean milk yield	Mean glucose	Mean β-hydroxybutyrate	Gestation length
Heart girth	0.41*	0.11	0.01	0.45*
Hip height	0.31	0.30	-0.09	0.22
Wither height	0.23	0.19	0.15	0.29
Glucose	-0.31	0.07	0.30	-0.18
Mean heart rate	-0.29	0.06	-0.06	-0.14
Mean arterial pressure	0.01	0.38†	0.07	0.07
Pulse pressure	0.26	-0.26	-0.38†	0.13
Mean resistance index	-0.32	-0.21	0.01	-0.14
Mean pulsatility index	-0.06	-0.26	-0.13	0.06
Mean blood velocity	-0.19	0.17	0.08	0.13
Mean blood flow	-0.21	0.26	0.19	0.09

*$P \leq 0.05$, †$P > 0.05$ but ≤ 0.1

Heart girth at birth was positively correlated to the mean milk yield of the dam ($P = 0.05$) and length of gestation ($P = 0.02$; Table 3). It was expected that a longer gestation would result in a larger calf at birth. The correlation between milk yield and heart girth is not as easy to explain, but could be because larger cows tend to produce more milk and they also produce larger calves. It may also be related to feed intake, however, individual feed intake was not recorded. All other growth characteristics at birth were not significantly correlated to the variables measured in the dam (Table 3).

Mean arterial pressure (Table 3; $P = 0.07$) tended to be positively correlated to mean concentration of glucose in the dam. Pulse pressure tended to be negatively correlated to the mean concentration of BHBA ($P = 0.06$) in the dam. Both of these correlations indicate that the energy status of the dam may influence characteristics of the calves, after they are born. This is similar to past research indicating that nutrient availability *in utero* is important to the health and viability of the offspring. All other cardiovascular characteristics of the calves at birth were not correlated to the dam.

At 1 month of age, heart girth was no longer correlated with mean milk yield (Table 4; $P = 0.14$) but still tended to be ($P = 0.09$) positively correlated to gestation length. Hip height in calves at one month of age was ($P = 0.02$) positively correlated to milk yield in dams. Wither height at one month of age was positively correlated to

mean concentration of glucose (P = 0.02) and gestation length (P = 0.01). Wither height at 1 month of age also tended to be (P = 0.07) positively correlated to milk yield in dams. It was interesting that fewer correlations existed between size characteristics and measurements in dams when the calves were born compared to when they were at one month of age (Table 4).

Concentrations of glucose in calves at 1 month of age were (P = 0.03) positively correlated to concentrations of BHBA of their dam. Gestation length was (P = 0.01) negatively correlated to mean RI of calves at one month. Mean milk yield tended to be (P = 0.08) negatively correlated to MAP but tended to be positively correlated to mean PI of calves at one month. Mean blood velocity at one month was (P = 0.01) negatively correlated to milk yield as well. Similar to the correlations with milk yield and birth weight, it is difficult to speculate on an explanation for these correlations. It is clear that connections exist and further research is necessary to elucidate these explanations.

Table 4. Pearson correlations (r) between cardiovascular measurements in calves at 1 month of age and in dams during early gestation

Measurement at 1 month in calves	Measurements in dams during early gestation			
	Mean milk yield	Mean glucose	Mean β-hydroxybutyrate	Gestation length
Heart girth	0.39	0.39	-0.10	0.43†
Hip height	0.60*	0.06	-0.14	0.39
Wither height	0.47†	0.57*	-0.17	0.62*
Glucose	0.18	-0.09	0.58*	-0.38
Mean heart rate	0.17	-0.39	0.02	-0.23
Mean arterial pressure	-0.46†	-0.25	-0.05	0.01
Pulse pressure	0.08	0.31	0.19	-0.11
Mean resistance index	0.11	-0.19	0.27	-0.59*
Mean pulsatility index	0.44†	-0.14	0.03	-0.39
Mean blood velocity	-0.61*	-0.13	0.13	0.02
Mean blood flow	-0.30	0.31	0.30	0.10

$^{*}P \leq 0.05$, $^{\dagger}P > 0.05$ but ≤ 0.10.

Implications

Previous research has shown the importance of maternal nutrition during gestation on the offspring. These effects are most noticeable when nutrient restriction occurs during late gestation, as that is the time of the majority of fetal growth and development. However, it is becoming clearer that early gestation is an important time for embryonic, placental, and fetal development. Monitoring early gestational nutrient requirements may be more important than what was once thought. Further research on maternal nutritional intake during specific time points in gestation may elucidate novel beneficial

strategies in improving the potential of offspring.

In conclusion, these correlations lead to speculation that early gestational environment may impact growth and some hemodynamic parameters in young calves. Further research can lead to understanding the correlations and implications they may have on the dairy industry.

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Integrative Approaches to Improve Animal Fertility

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Research Summary

Fertility is one of the key traits controlling reproduction and development in animals. The objectives of recent studies in our laboratory were to ascertain molecular and cellular determinants of sperm viability to improve bull fertility. To accomplish these objectives, apoptosis, microRNAs and histones were examined in sperm from low *vs.* high fertility bulls. The results showed that 1) apoptosis in sperm was not associated with bull fertility, 2) there were microRNAs differentially present in sperm from low *vs.* high fertility bulls, and 3) significant amounts of core histones were present in the bull sperm. The results are significant because they advance our understanding of fundamental biology of male gametes and early embryos, and the identified biomolecular markers can be used to improve semen quality and predict bull fertility.

Introduction

Although considerable amounts of progress have been made in improving other traits such as milk production and meat quality, fertility has been a challenge both in dairy and beef cattle production. Despite the fact that some bulls produce ample amounts of sperm with normal motility and morphology, their fertility is low following artificial insemination of hundreds of cows. The hypothesis is that molecular defects in sperm from low fertility bulls prevent fertilization and activation of the egg or early embryo development.

Apoptosis, i.e. programmed cell death, is believed to damage sperm DNA, thus affecting the fertility rate, and clearing out damaged cells. Therefore, abnormal apoptosis could hinder the healthy development of sperm. It was recently discovered that higher amounts of apoptotic sperm decrease sperm viability. Therefore, the relationship between apoptosis and sperm fertility is of interest.

MicroRNAs (miRNAs) are small non-coding RNAs that regulate gene expression by preventing translation of messenger RNAs or degrading them. Although it is known that sperm contain large repertoires of miRNAs, their function in sperm and fertilization are not well understood.

Sperm chromatin structure is important for sperm physiology. Although it is accepted that during spermatogenesis, most histones are replaced by protamines, recent evidence shows that sperm do contain significant amounts of histones. However, functional associations between sperm histone retention and bull fertility are not known.

Procedures

To study the effects of apoptosis on sperm fertility, DNA damage, phosphatidylserine translocation, and pro/anti-apoptotic protein expression was

concluded using sperm samples from five low fertility bulls and five high fertility bulls (Dogan et al., 2013).

For the sperm miRNA study, sperm from eight high and low fertility bulls were used to isolate the RNA followed by miRNA microarray to profile the miRNAs. Sperm from six bulls with varying fertility bulls were used to determine expression dynamics of the seven of the differentially expressed miRNAs from the microarray experiments using real time reverse transcriptase PCR, qPCR (Govindaraju et al., 2012).

For the sperm histone study, sperm from 16 high and low fertility bulls were analyzed. Localizations and expression levels of core histones were determined using immunoblotting, immunocytochemistry and staining methods. The H2B, H3.3, and H4 histone sequences were compared among mammals (human, bovine, and mouse) using computation al biology methods (de Oliveira et al., 2013).

Results

Ultimately it was discovered that the amounts of apoptotic sperm had no relation to fertility (Table 1). Future studies should be conducted to analyze the roles of apoptotic proteins (Dogan et al., 2013).

Results of the miRNA microarray experiments showed that sperm from both high and low fertility bulls had large amounts of miRNAs. Seven of these miRNAs were associated with bull fertility (Figure 1). These differentially expressed sperm miRNAs may play important roles in fertilization and activation of the egg and/or during early embryonic development (Govindaraju et al., 2012).

Table 1. Molecular and cellular characteristics of sperm from low *vs.* high fertility bulls (Dogan et al., 2013). All parameters that were used for the analysis are the percentage of flow cytometric Annexin V assay results as necrotic, early necrotic, viable, apoptotic spermatozoa, and the ratio of DNA fragmented spermatozoa determined by TUNEL, the percentage of alive spermatozoa according to eosin-nigrosin test, the expression (μg) of pro-apoptotic protein BAX determined via western blotting. All responses are compared between two groups and listed as mean and standard division including p-values

Parameters	High (Mean ± SD	Low (Mean ± SD)	p-value
Necrotic spermatozoa	3.48 ± 1.59	4.13 ± 1.86	0.079
Early necrotic spermatozoa	31.04 ± 9.27	32.13 ± 9.26	0.579
Viable spermatozoa	62.62 ± 9.1	60.72 ± 8.51	0.311
Apoptotic spermatozoa	2.86 ± 1.31	3.00 ± 0.96	0.548
DNA fragmented spermatozoa	3.51 ± 2.23	3.61 ± 2.20	0.826
Alive spermatozoa	52.60 ± 7.06	59.27 ± 8.61	0.028*
Western blot	2.47 ± 0.72	3.36 ± 3.23	0.283

Studies on sperm histones showed that there were significant amounts of H2B, H3.3, and H in the sperm (Figure 2). Bioinformatics studies showed that H3.3 and H4 proteins were completely conserved and may be functionally identical among humans, bulls, and mice (de Oliveira et al., 2013).

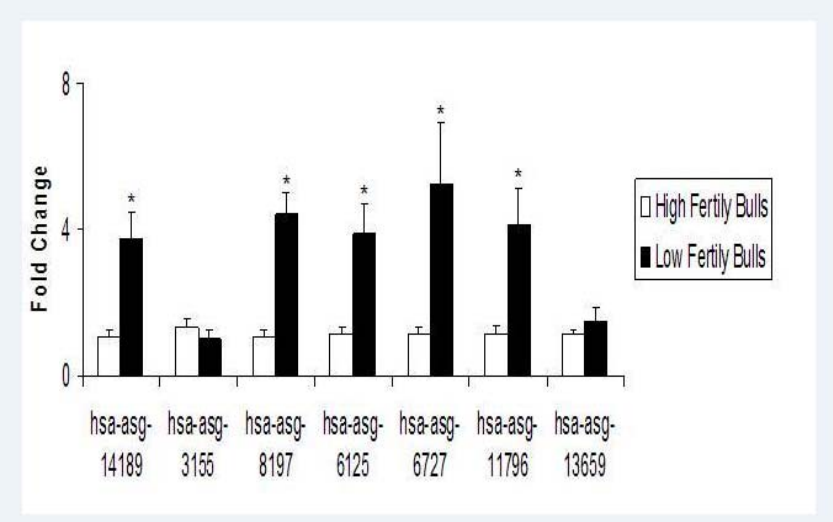

Figure 1. Expression dynamics of seven miRNAs in sperm from six bulls with varying fertility as detected using quantitative real time reverse transcriptase PCR (Govindaraju et al., 2012). Data were presented as mean value ± SEM for each miRNA, and * indicates statistical significance at $P < 0.05$.

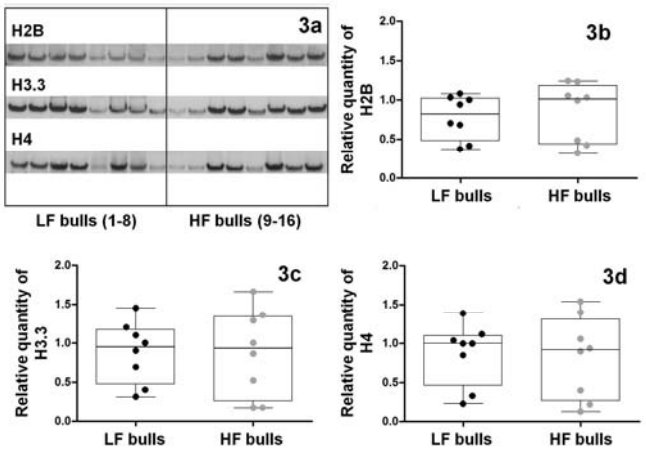

Figure 2. Histone proteins in bull sperm: Western blot (3a) and relative quantity of H2B (3b), H3.3 (3c) and H4 (4d) from low fertility (LF) (black dots) and high fertility (HF) (grey dots) groups (de Oliveira et al 2013). The relative quantity was obtained by calculating the ratio between the band intensity of each bull and the band intensity of the bull 1. The middle lines are medians, edges of the box are the 25th and 75th percentile and the whiskers are the minimum and maximum values. There were significant differences between groups.

Implications

These findings are significant for the scientific community as well as society because they provide new knowledge of the influence of mammalian spermatozoa on fertilization and embryo development. This can contribute to future improvements in animal fertility and genetics.

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Effects of Various Nitrogen Fertilizer Sources on Biomass and Forage Quality of Annual Ryegrass

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Research Summary

Twenty (4 ft x 11 ft) plots on a prepared seedbed were planted with 'Marshall' annual ryegrass at a rate of 30 lb per acre on October 12, 2012 to test the effects of four different nitrogen (N) fertilizer sources on forage biomass, and quality parameters of annual ryegrass (*Lolilum multiflorum*). Treatments were applied to deliver 60 lb of N per acre on the following dates: November 14 and December 19, 2012 and January 25 and March 15, 2013. Treatments were: Control, no additional N applied throughout the growing season; encapsulated urea (ESN); Urea (UREA); a 50:50 blend of ESN and Urea (COMBO), and Ammonium Nitrate (AMMO). Plots were mechanically harvested at four dates during the growing season (2012 to 2013), weighed, dried to determine dry matter (DM) yield per acre, and analyzed for quality parameters using NIR. Data were analyzed as a randomized complete block, with block as a random effect and treatment as the fixed effect. Fertilizer source did not affect ($P > 0.05$) forage biomass at the first or third harvest. Plots treated with ESN, UREA or the COMBO had greater biomass than the control or the AMMO ($P < 0.05$) at the second harvest. All fertilizer sources had greater biomass ($P < 0.05$) than the control for the fourth harvest and total harvest. No differences ($P > 0.05$) among any treatments were noted regarding forage quality (CP and ADF) at any point in the study. Results indicate that N fertilization (regardless of type) of annual ryegrass will increase yields, with no effect of quality.

Introduction

South Mississippi produces approximately 300,000 acres of annual ryegrass (*Lolilum multiflorum*) per year (Lemus, 2008 unpublished). Cool-season annuals such as annual ryegrass are typically high in nutrients (Ball et al., 2002), and can support a high rate of performance (Hafley, 1996). However, due to the high production potential, they require high nutrient input. Urea can be an inefficient N source due to volatilization (Lemus, 2011 and Watson et al, 1990), especially in the summer months. Some data have shown the potential for encapsulating fertilizers with polymers to reduce some of those losses (Jahns and Kaltwasser, 2000). Therefore the scope of this project was to determine if an encapsulated urea applied as a fertilizer would result in an improvement of nutrient utilization by annual ryegrass.

Procedures

Twenty (4' x 11') plots were laid out on a prepared seed bed. Plots were planted on October 12, 2012 with 'Marshall' 2012 annual ryegrass (*Lolilum multiflorum*), at the rate of 30 lb per acre. At planting, 400

lb/acre of 15-5-10 (N-P-K) was applied as a starter fertilizer. There were four blocks with each of the five treatments represented in each block. Treatments were various fertilizers and combinations: Control, no additional N applied throughout the growing season; encapsulated urea (ESN); Urea (UREA); a 50:50 blend of ESN and Urea (COMBO), and Ammonium Nitrate (AMMO), delivered three times (Table 1) during the growing season. A plot map with treatments randomly applied to each block was generated. On November 14, 2012, initial treatments were applied to each plot. Plots were harvested using a Ferris commercial mower with a bagging system. A 52-inch swath was removed to a 3-inch stubble height from the center of the plot to avoid border effect (Table 1). At each harvest, forage biomass was collected as well as samples for DM determination and subsequent quality analysis. Samples were dried in a forced-air oven at 40^{o}C for 48 h, ground through a 2-mm Wiley mill and subsequently analyzed for nutritive value parameters using NIR technology.

Statistics

Data were analyzed as a randomized complete block using the Mixed Model procedure of SAS. Treatment was a fixed effect and Block was a random effect. Significance was declared at $P < 0.05$.

Results

Results are presented in Table 2. No effects of fertilizer type ($P > 0.05$) were noted for the first harvest. However, for the second harvest a significant effect ($P < 0.002$) was noted with the UREA, COMBO and ESN treatments resulting in greater forage biomass than Control or AMMO. This may be due to the mild temperatures and high rainfall that occurred that month which may have improved the efficiency of urea utilization by the plant (Lemus, 2011). Surprisingly AMMO and Control did not differ ($P < 0.10$), which might have been due to increased leeching from the high rainfall amount. Hovermale (1993) showed greater forage DM yield when 68 lb/acre of ammonium nitrate was applied to annual ryegrass plots compared to controls. A tendency ($P < 0.16$) was noted for the third harvest, with fertilized plots being numerically greater than control, with ESN having the numerically highest forage biomass. A significant effect was noted ($P < 0.002$) for the fourth harvest, and with all harvest totals with all fertilizer sources increasing forage biomass compared to controls. Similarly, Bovis and Touchton (1998) examined different fertilizers with or without urease inhibitor (to reduce volatilization) on wheat and annual ryegrass yields and noted no difference.

Table 1. Timeline of events during 2012 to 2013 study.

Item	Date	Item	Date
Plots planted	10/12/2012	Second harvest	1/24/2013
Treatment applied	11/14/2012	Third harvest	3/8/2013
First harvest	12/14/2012	Treatments applied	3/15/2013
Treatments applied	12/19/2012	Fourth harvest	4/13/2013

Table 2. Effects of various N fertilizers on growth and quality of annual ryegrass.

	Treatments						
Item	Control	ESN	Urea	ESN+Urea	Amm.Nit	SE	*P*<
DM Yield, lb/ac[c]							
Period 1	844.06	1051.91	1086.76	995.44	874.77	133.49	0.45
Period 2	937.54[y]	1417.58[z]	1195.39[z]	1197.36[z]	1084.28[y]	95.83	0.002
Period 3	1053.75	1584.56	1288.89	1357.52	1326.17	133.60	0.15
Period 4	906.88[y]	2159.73[z]	3262.26[z]	2494.92[z]	2890.21[z]	311.33	0.002
Total	3742.23[y]	6123.78[z]	6833.30[z]	6045.22[z]	6175.42[z]	463.35	0.002
Crude Protein, DM basis							
Period 1	23.41	23.00	24.05	25.41	24.69	0.74	0.17
Period 2	21.05[x]	23.52[xyz]	23.70[yz]	23.87[yz]	22.90[xyz]	0.63	0.05
Period 3	12.08	14.47	13.43	14.25	13.15	0.71	0.20
Period 4	14.35	15.33	15.15	15.07	15.14	1.30	0.99
ADF[d], DM Basis							
Period 1	27.27	27.37	28.21	26.37	27.82	0.74	0.48
Period 2	25.63	25.12	25.34	24.76	25.10	0.53	0.83
Period 3	24.31	24.61	24.46	24.60	24.63	0.64	0.99
Period 4	27.83	27.97	28.61	28.35	28.38	0.45	0.73

[a]All plots planted on 10-12-2012, with 400 lb/acre of 15-5-10 starter fertilizer. Treatments were applied to deliver 60 lb of N per acre on the following dates: 11-14-2012, 12-19,2012, and 03-15-2013. Treatments were various fertilizers and combinations: ESN, encapsulated urea; Urea; ESN+Urea, a 50:50 blend of ESN and Urea, and Ammonium Nitrate

[b]Standard error of treatment means.

[c]Dry matter yield per acre. Periods were the harvest dates of 12-14-2012, 01-24-2013, 03-08-2013, and 04-13-2013

[d]ADF = Acid detergent fiber

[xyz]When the overall *P*-value was significant ($P < 0.05$), least square means without a common subscript differ ($P < 0.05$).

Implications

Nitrogen fertilizer increased yields of annual ryegrass compared to a non-fertilized control. No major differences were noted regarding the type of fertilizer used. Due to lower temperatures and humidity observed in the spring, urea type fertilizers may be more efficient than ammonium nitrate. Other factors such as cost and availability might be a more important factor in determining fertilizer preferences.

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Evaluation of Injectable Hay Additive on Quality and Intake of Bermudagrass/Bahiagrass Mixed Hay by Beef Cows

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Research Summary

An experiment was conducted to evaluate the use of injectable hay additive on hay quality and feed preference by mature beef cows. Twelve round hay bales (bermudagrass/bahiagrass) approximately 850 lbs. were allotted to one of two treatments: injection of a high protein hay additive or left alone (control). Hay samples were collected (six core samples per bale) prior to injection and at 4, 10, and 22 days post injection. Samples were dried (48 hours at 50^{o}C) then ground to 2 mm through a Wiley Mill and subsequently analyzed for quality using NIR technology. Additionally, four bales (two from each treatment) were weighed, sampled and placed in two large pastures where beef cows (n = 35, blocks 1 and 2; n = 42 block 3) had free choice access to the bales. For a period of 3 to 4 hours a day, cows were moved to annual ryegrass pastures that they limit grazed. After 4 days, residue from each bale was weighed sampled for DM analysis and discarded. This process was repeated two more times (three blocks). Bales were spatially separated and never were placed in the same location twice. Feed intake data were analyzed as a mixed model with fixed effects of treatment and random effects of block. Forage quality data were analyzed as a mixed model with fixed effects of treatment, time (pre and post injection) and any interactions, and random effects of block. A time x treatment interaction (P = 0.04) was noted for ADF, with bales injected with additive decreasing in ADF from 44.33% (pre-injection) to 43.40 (post injection) (P = 0.16). Other than these differences no statistical differences (P > 0.10) were noted for any other quality parameter (NDF, CP, Ca, and P). Cows showed no preference between bales not injected and bales injected with additive (P > 0.10), with cows consuming 466 lbs of control hay (DM basis) compared to 477 lbs of injected hay (DM basis). Results suggest that injection of a hay additive did not affect quality parameters, nor were any effects on feed preference noted.

Introduction

Data compiled from the Southeast LSU Research Center in Franklinton (Lemus and Rivera, unpublished data) have shown that average quality for hay samples submitted from Mississippi is rather low (average CP = 8.1, TDN 51%), and would not support a beef cow in most stages of production (NRC, 2000). Many producers turn to supplementation, to make up these differences, however with rising commodity prices, and the increase in labor required, supplementation is not always the most cost effective. One method to improve hay quality that has been discussed is the use of injectable additive. Therefore, our objective was to evaluate the use of two

liquid additives on hay quality and feeding preference by beef cows.

Procedures

All procedures involved were approved by the Mississippi State University Animal Care and Use Committee.

Hay treatment

Round bales produced at the White Sand Branch Research Unit, in Poplarville, Mississippi in the summer of 2012 were used for the study. Treatments were originally designed to be 1) control, no additive injected; 2) commercial additive that is marketed as a hay injection (Haymaster; Table 1), and 3) a liquid feed that is not marketed as a hay injection.

Bales were randomly selected, weighed, core sampled (8 locations per bale), individually identified, and were randomly assigned to treatment. Control bales received no injection. Bales treated with Haymaster were treated with the 3 gallons of injection (per manufacturer's instruction). The third treatment of injecting a commercially available liquid feed did not work; the high soluble content of the liquid feed did not flow through the injection system. Therefore it was determined to soak the bale with the liquid feed, however, the liquid fraction "soaked " into the bale, however, high quantities of solubles were left on top and did not penetrate the bale. Despite our hypothesis, we determined that commercially available liquid feed would not work as a method to treat round bales, and this treatment was eliminated from the study design.

Bales were left alone following injection for at least 5 days prior to the initiation of feeding. Prior to feeding, bales were weighed, core sampled (8 times from each bale), and randomly placed in a common pasture with cows and calves. The cows were the crossbred multiparous commercial herd at the White Sand Unit, and calves ranged from 1 to 3 months of age. Two bales from each treatment were placed in the same pasture, and randomly assigned to location. This was repeated in two other blocks or pastures and different days following initial injection (Table 2). Cows in each pasture had limited access to graze cool-season annuals (3 to 4 hours/day, as weather permitted) during the day (Table 2) based upon weather conditions. Following a 4-day consumption period residue from the bales were collected, weighed and sampled for DM analysis. Hay disappearance was calculated with these differences. To account for any differences in pounds of feed offered, the amount of hay consumed was transformed using Chessons, (Chesson, 1978), and those index values were analyzed.

Sample analysis

All collected samples were weighed, and then dried in a forced air oven at 100 ^{o}F for 48 hours. Following drying, samples were weighed again and a DM was calculated. Samples collected prior to, and following injection were analyzed for forage quality [crude protein (CP), acid detergent fiber (ADF), nutrient detergent fiber (NDF), using the Foss 6500 NIR System (Foss, Eden Prairie, MN) and the mixed hay equation from the NIRS Feed and Forage Testing Consortium.

Data analysis

Disappearance data were analyzed as a mixed model randomized complete block, with pasture as the random effect.

Treatment was the fixed effect. Hay quality was analyzed as a mixed model and the effects of treatment and time (pre- and post-injection) were analyzed as fixed effects, with block being a random effect.

Table 1. Nutrient concentration of hay injection additive[a].

Item	Concentration
Crude Protein[b], %	20.00
Fat, %	0.10
Calcium (min.), %	0.25
Calcium (max.), %	0.75
Cobalt, ppm	8
Iron, ppm	180
Manganese, ppm	200
Zinc, ppm	240
Iodine, ppm	20

[a]Based upon label indications. [b]Not more than 18% from non-protein nitrogen.

Results

Hay disappearance

Results for hay disappearance are presented in Table 2. No differences were noted regarding hay disappearance (P = 0.92). Additionally, no differences (P = 0.91) were noted with regard to Chesson. Although not significant (P = 0.11), a tendency was noted for pounds of hay offered. Because Chesson, takes into account different availability in the calculation, the authors felt that this should account for any differences in feed offered. Based upon consumption patterns, cows did not show a preference to either treatment. Results indicate that application of a hay injection treatment did not affect hay preference. Krueger et al. (2008), determined that ammonia treated hay increased DMI, however ammonia treatment was much higher in concentration and was applied at baling. Rutter (2005) showed that ruminants (cattle and sheep) have a 70% preference for legumes compared to grasses. However, it is unclear if there is a nutrient requirement driving this selection. It should be noted, however, that at various times during the study cows had access to cool season annuals for a period of time. It was presumed that the majority of nutrients required by the animal were obtained from grazing, therefore, nutrient demand may not have been the driver for hay preference.

Table 2. Days of annual ryegrass limit grazing per trap

Pasture number	No. cattle[a]	Days monitored[b]	Grazing time hour/day[c]
4	35	4	4
7	35	4	3
6	42	4	3

[a]Cows only, calves not counted.
[b]Number of days treatment bales were offered.
[c]Time cows were allowed to graze annual ryegrass pastures.

Hay quality. Hay quality data are presented in Table 3. As expected, no differences were noted regarding ADF, prior to injection (P = 0.35), nor did injection have an effect on hay quality, however there was a time by treatment interaction (P = 0.04) regarding acid detergent fiber (ADF). There was a tendency (P = 0.16) for ADF to decrease with injection of hay treatment, however, these did not differ between treatments (P = 0.53). It is unclear as to what might have occurred with ADF. Neutral detergent fiber (NDF) did not differ with treatment (P = 0.60), time (P = 0.73), nor was there an interaction (P = 0.87). Similarly, crude protein was not affected by treatment (P = 0.95), time (P = 0.54) nor was an interaction evident (P = 0.70). Treatment did not affect calcium (P = 0.89) or phosphorus (P = 0.59). Time did not influence either calcium or phosphorus (P = 0.95 and 0.42, respectively), nor was an interaction present for either (P > 0.71). Based upon the label of the hay additive, it did contain a high level of urea. Previous studies have shown that ammoniation of hay (Brown, 1991) can improve the quality; however, this application usually occurs at baling and over a long period of time. Additionally, Brown (1991) did not show any improvement in ADF. Similarly, (Krueger et al., 2008) showed improvement in hay quality and animal performance. Krueger et al. (2008) used ammonia treatment at 3% of DM of bale while in the current study we used additives at approximately 3% of DM of bale, however, the overall N of the injection used in the current study was much lower than ammonia used by Krueger et al. Moreover, ammonia treatments were applied by spraying on top of bales that were then covered and allowed to react with ammonia for 6 weeks prior to feeding. During the injection process it was observed by personnel that some of the injection was leaking back out the injection sites, therefore it is unclear to what extent the liquid was able to permeate throughout the bale.

Table 3. Feed disappearance (DM Basis) of injected or non-injected hay bales fed to beef cows.

	Treatment[a]			
Item	Injection	Control	SE[b]	*P*-value
Hay offered, lbs	735.2	770.80	17.80	0.12
Hay disappeared, lbs	477.5	466.50	75.90	0.92
Percent disappeared	65.00	60.70	9.98	0.77
Chesson[c]	8.18	8.49	1.88	0.91

[a]Injection of a commercial hay additive (3 gallons per bale) and control(no injection).
[b]Standard error of treatment means.
[c]Chesson's Index of selectivity based upon availability

Table 4. Effects of hay injection on overall forage quality, post-injection.

	Treatment[a]			
Item	Injection	Control	SE[b]	*P*-value
ADF, %[c]	43.96	43.40	0.29	0.53
NDF, %[d]	71.15	71.52	0.71	0.95
CP, %[e]	7.88	7.71	0.50	0.99
Calcium, %	0.52	0.51	0.02	0.99
Phosphorus, %	0.19	0.19	0.005	0.90

[a]Injection of a commercial hay additive (3 gallons per bale), Control, no injection.
[b]Standard error of treatment means.

Table 5. Effects of hay injection on hay quality.

	Time[a]			
Item	Pre	Post	SE[b]	*P*-value
ADF, %[c]	44.33	43.40	0.42	0.16
NDF, %[d]	71.46	71.15	0.85	0.98
CP, %[e]	7.50	7.88	0.53	0.89
Calcium, %	0.52	0.51	0.02	0.99
Phosphorus, %	0.18	0.19	0.005	0.83

[a]Injection of a commercial hay additive (3 gallons per bale), Control, no injection.
[b]Standard error of treatment means.

Implications

Results of the current study indicate that injection of a hay additive at label indications did not improve hay quality, nor did it improve animal selection preference. It is unclear if increased amount of product might improve overall hay quality; nor is it clear whether ryegrass grazing affected selection preference, therefore further work is required. There is also the need to evaluate more efficient methods of injecting additives into the bales and evaluating homogenous solutions instead of solutions with high soluble content (large particles).

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Effects of Supplement or Fertilizer on Forage Quality, and Performance of Stocker Cattle Grazing Warm-Season Pastures in South Mississippi

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Research Summary

Crossbred (*Bos taurus* × *Bos indicus*) beef steers (BW = 493.9 lbs; n = 54) were used over 2 years to examine the efficacy of nitrogen fertilizer compared with feed supplementation on forage quality, animal production, and nitrogen cycling. Steers were weighed and assigned to graze six 4-ha paddocks of mixed warm-season perennials (bermudagrass and bahiagrass) for an average of 126 days. Paddocks were randomly assigned to one of three treatments: no fertilizer and no supplement; supplement of 2.4 lbs of DDGS per steer (DM Basis) and no fertilizer; or fertilizer (60 lb N per acre) and no supplement. Cattle were individually weighed every 28 days and individual fecal samples were collected. Pasture clippings were taken weekly and pooled for nutrient analysis for each 28-day period. Data were analyzed as a randomized complete block with year and block as random effects and pasture as the experimental unit. Supplement increased BW ($P < 0.04$) at days 56, 84, 112 and for the overall grazing period. No differences ($P > 0.10$) were noted regarding BW in steers that grazed fertilized pastures or non-fertilized pastures at any point in the study. Supplement also increased ($P < 0.05$) ADG at days 56, 84, 112, and for the overall study compared to grazing alone (regardless of fertilizer). Moreover, ADF in forage samples was reduced ($P < 0.07$) in pastures that were fed a supplement or fertilized at days 56, 84 and for the overall study. In addition, CP was increased ($P < 0.06$) by supplementing or fertilizing at d 56, 112 and for the overall study. Finally, pasture TDN at days 56, 84 and overall was increased ($P < 0.07$) by supplementing or fertilizing. In year 1, fecal N increased at day 28 ($P < 0.05$) for supplemented cattle compared with their counterparts, increased at day 56 ($P < 0.09$) for both supplement and fertilizer groups, and increased at day 84 for the fertilizer group. Overall fecal N was increased ($P < 0.08$) using either supplement or fertilizer application. Results suggest that supplementing cattle grazing warm-season pastures will improve performance compared to fertilization with no negative consequence to pasture quality.

Introduction

With rising input costs, beef cattle producers are forced to make decisions based upon the return on investment. Chemical fertilizer application is a common used method by beef cattle producers in the southeastern United States to improve pasture yield and quality (Ball et al., 2002). Application of 67 lbs N/acre to smooth bromegrass pastures resulted in an increase of crude protein by two percentage points, and resulted in greater gain per ha (Greenquist et al., 2009). However, Mosier et al. (2001) noted that application of commercial fertilizer is often in excess of

plant uptake, with the plant only fully utilizing 17 to 50%. With recent changes regarding commodity and fertilizer prices, the practice of fertilizer application falls under closer scrutiny. Perhaps management of N applied to the animal directly in the form of supplement would be a more efficient use of resources, while reducing the environmental impact, moreover, since N is being delivered directly to the animal producers might see a more direct effect of N supplementation on cattle performance.

Procedures

Cattle

Fifty-four crossbred beef steers (24 in year 1, and 30 in year 2), were weaned from the Brown Loam Branch Station in Raymond, Mississippi in early May of both 2011 and 2012. In mid- to late May, the cattle were shipped to the White Sand Branch Station outside of Poplarville, Mississippi. Upon arrival, calves were allowed to settle into their new environment for 48 hours (2011) and 24 hours (2012), after which they were weighed, stratified by BW to treatment assignment and moved to the pastures. Cattle were weighed every 28 days, and at each weigh period, a fecal sample was collected for N analysis. In year 1 (2011), cattle grazed a total of 120 days, and in year 2 (2012), they grazed a total of 135 days.

Pastures

Pastures were the typical summer pastures found of the White Sand Branch Unit, consisting of bahiagrass and bermudagrass mix. Approximately 45 days prior to the initiation of the study, all pastures were fertilized with P and K and adjusted for pH based upon soil test requirements so that those nutrients were consistent among all pastures. Weekly forage samples were collected and pooled for each weigh period and analyzed for CP, ADF, and TDN. In 2011, the samples were analyzed at a commercial feed lab (MidWest Labs, Omaha, NE), and in 2012 all samples by the MSU Forage Quality Research Laboratory using the hay equation from the NIRS Feed Consortium. In both instances, samples were analyzed using an NIR.

Study Design

The study was a randomized complete block with both block and year used as random effects, and treatment as the main effect. Pasture was the experimental unit and there were six pastures total per year (12 total pastures in the analysis). In 2011, the pastures were stocked at the rate of 4 head per paddock and 5 head per paddock in 2012. Grazing was managed as continuous grazing and put and take cattle were inserted as needed to maintain adequate available forage biomass. Treatments were: Control: no N applied throughout the growing season; Fertilizer: N applied at the rate of 60 lbs N/acre acre in 50:50 split application approximately 30 days before the arrival of the calves, and again approximately day 70 of the study; and Supplement: no N applied to the pastures throughout the growing season, however, the cattle were supplemented with 4.8 lbs (DM basis) of distillers dried grains with solubles (DDGS) every other day. Pastures were 3 acres in size for both the Supplement and Fertilizer groups, and 4 acre in size for the unfertilized group. This increase in paddock size was done to avoid any forage shortages due to the lack of N applied to the pasture.

Results

Animal performance

Body weight data are presented in Figure 1. Treatment had no effect on BW at either day 0 or 28 ($P > 0.10$). However, cattle on the Supplement treatment had greater BW at days 56, 84, 112, and at the end of the study ($P < 0.05$). Average daily gain (ADG; Table 1) was not different among treatments during the first 28 days ($P = 0.49$). Nonetheless, ADG increased ($P < 0.08$) for cattle fed supplement compared to cattle on unfertilized pastures or fertilized pastures. No differences were noted between fertilizer and control pastures. Total gain per acre was greater for supplemented cattle compared to the other two treatments.

Table 1. Performance of grazing beef steers on unfertilized warm-season perennials, fertilized warm-season perennials, or supplemented on unfertilized warm-season perennials.

Item	Fertilizer[a]	Supplement[a]	Control[a]	SE[b]	*P*-value[c]
		Body weight, lbs			
Day 0	495	495	493	18.6	0.79
Day 28	560	579	561	13.5	0.55
Day 56	536[y]	569[z]	535[y]	14.6	0.03
Day 84	562[y]	597[z]	558[y]	13.5	0.05
Day 112	566[y]	607[z]	555[y]	14.5	0.001
Final BW[d]	565[y]	619[z]	560[y]	15.8	0.003
		Average Daily Gain, lb/d			
Days 0 to 28	1.73	2.18	1.62	0.29	0.49
Days 0 to 56	0.71[y]	1.31[z]	0.80[y]	0.12	0.02
Days 0 to 84	0.79[y]	1.21[z]	0.78[y]	0.2	0.08
Days 0 to 112	0.61[y]	1.02[z]	0.62[y]	0.18	0.005
Total	0.59[y]	0.91[z]	0.53[y]	0.18	0.01
Total Gain per acre, lb	23.3[x]	41.4[y]	16.7[z]	5.6	0.001

Treatments were Fertilizer: Pastures fertilized with 60 lb N in two applications; Supplement: No fertilization, but cattle fed 4.8 lb of DDGS every other day; or Control: Pastures neither fertilized nor cattle supplemented
[b]Standard error of treatment means, [c]*P*-value, significance declared at $P < 0.10$, [d]Total grazing period in 2011 (120 days) and in 2012 (135 days)
[xyz] Means without a common superscript differ

Forage nutritive value

Data regarding forage nutritive value are presented in Table 2. Acid detergent fiber (ADF) was different for cattle fed supplement or fertilized pastures compared to control at days 0 to 28, days 56 to 84, days 84 to 112 and for the overall study ($P < 0.07$). At days 28 to 56 and days 84 to 112 there were no differences detected ($P > 0.10$). In a similar fashion crude protein (CP), was similar between Supplement and Fertilize groups ($P > 0.10$), but were in fact significantly different from Control at all periods except days 28 to 56. This same

effect was noted for total digestible nutrients (TDN) at all periods except days 28 to 56 and days 84 to 112.

Table 2. Forage quality parameters of pastures of fertilized, unfertilized, or supplemented beef cattle.

Item	Fertilizer[a]	Supplement[a]	Control[a]	SE[b]	*P*-value[c]
Days 0 to 28					
Acid detergent fiber	33.9y	34.6y	36.4z	1.89	0.07
Crude Protein	14.22^{x}	12.9^{y}	10.7^{z}	1.1	0.07
Total Digestible Nutrients	60.4	59.4	57.2	1.7	0.06
Days 28 to 56					
Acid Detergent Fiber	35.65	35.1	37.3	1.8	0.57
Crude Protein	11.9	12.4	9	1.1	0.26
Total Digestible Nutrients	58.2	58.8	55.8	1.5	0.34
Days 56 to 84					
Acid Detergent Fiber	37.3^{y}	35.1^{y}	39.2^{z}	1.6	0.03
Crude Protein	14.2^{y}	12.^{7y}	9.4^{z}	0.61	0.06
Total Digestible Nutrients	57.8^{y}	58.9^{y}	54.4^{z}	1.3	0.006
Days 84 to 112					
Acid Detergent Fiber	37.9^{y}	38.4^{yz}	40.9^{z}	2.2	0.07
Crude Protein	13.5^{y}	11.3^{y}	9.1^{z}	1.7	0.06
Total Digestible Nutrients	57.0^{y}	55.9^{yz}	53.2^{z}	2	0.03
Days 112 to end					
Acid Detergent Fiber	39.9	37.5	40.4	1.23	0.29
Crude Protein	13.0^{x}	10.7^{y}	7.9^{z}	0.65	0.06
Total Digestible Nutrients	55.4	56.3	53.1	0.8	0.14
Overall					
Acid Detergent Fiber	36.7^{y}	36.2^{y}	38.8^{z}	1.76	0.004
Crude Protein	13.4^{y}	12.2^{y}	9.5^{z}	0.47	0.002
Total Digestible Nutrients	57.9^{y}	57.8^{y}	54.8z	1.38	0.0005

[a]Treatments were Fertilizer: Pastures fertilized with 60 lb N in two applications; Supplement: No fertilization, but cattle fed 4.8 lb of DDGS every other day; or Control: Pastures neither fertilized nor cattle supplemented
[b]Standard error of treatment means, [c]P value, significance declared at P < 0.10, [d]Total grazing period in 2011 (120 d) and in 2012 (135 d)
[xyz] Means without a common superscript differ

Fecal N

Due to the project being an on-going project, only year one (2011) fecal N are reported. Fecal N increased at d 28 (P < 0.05) for supplemented cattle compared with their counterparts (2.52% for Supplement, 2.31% for Fertilizer and 2.21% for Control), increased at day 56 (P < 0.09) for both Supplement (2.56%) and fertilizer groups (2.55%), compared with controls (2.25%), and increased at day 84 for the fertilizer group. Overall fecal N was increased (P < 0.08) using either supplement (2.47%) or fertilizer (2.46%) application compared to controls (2.21%).

Implications

Results suggest more efficient use of N will occur in the form of a supplement. While N fertilization was able to increase forage quality compared to controls, those differences did not translate to increased performance. Fecal N was increased with both supplement and fertilizer; however, greater N use efficiency was noted with Supplement (when examined as body weight gain). While supplementation may be the most efficient use of N delivery for growing beef cattle grazing warm-season perennial pastures, other factors including total nutrient management (nutrients other than N), and weed control play an integral part of overall pasture health and productivity, therefore, all factors must be considered to determine the most optimal production system for long term benefit and use.

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Evaluation of Different Dietary Supplements for Cattle Consuming Annual Ryegrass Baleage

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Research Summary

A metabolism study was conducted to evaluate the digestibility and crude protein retention of annual ryegrass (*Lolium multiflorum* Lam.) baleage supplemented with hay or soybean hull pellets. Twelve crossbred steers (BW = 545 ± 45.8 lb) were halter broken and adapted to an annual ryegrass baleage for 14 days. Following the adaptation, steers were placed in individual metabolism crates for a total of 10 days. The steers were allowed ad libitum access to annual ryegrass baleage and allotted to 3 treatments: 1) no supplement (NS); 2) hay (H); and 3) soybean hull pellets (SH), with 4 steers per treatment group. Sample collections were for 7 days following a 3-day adaptation to the crates. Collections taken included: hand grab samples of feedstuffs and ORTS, fecal samples, and urine samples. Laboratory analysis was run on all samples, and data were analyzed using the GLM procedures of SAS with steer as the experimental unit. Dry matter intake (DMI) was different (P = 0.02), with steers fed NS (8.3 lb/day) and H (8.7 lb/day) consuming less than those fed SH (10.5 lb/day). However, DMI was not different (P = 0.1917) when body weight was accounted for ranging between 1.5 and 1.8% BW/day. Apparent digestibility of dry matter was not different (P = 0.7962) and ranged between 67 and 69%. There was no difference for apparent organic matter digestibility (P = 0.7998) which ranged from 70 to 71%. Apparent crude protein digestibility did not differ (P = 0.3965) and ranged from 53 to 58%. No difference was found for apparent NDF digestibility (P = 0.6401) with a range from 74 to 76%. Apparent hemicellulose digestibility did not differ (P = 0.6297) and ranged from 75 to 77%. Apparent fat digestibility was not different (P = 0.3096) with a range between 72 to 76%. Amount of protein retained was not different (P = 0.7322) and ranged between 0.4021 to 0.6984 oz. The results indicated there was no effect of supplementing a fiber source to cattle consuming annual ryegrass baleage.

Introduction

Annual ryegrass (*Lolium multiflorum* Lam.) is generally a highly nutritious grass that may be presented as forage for beef cattle through grazing, dried and fed out as hay, or ensiled and fed out as baleage. Ben-Ghedilia et al. (1995) documented NDF digestibility of 64.1% for diets based on annual ryegrass silage. Energy supplements fed to cattle consuming better nutritive value forage diets can potentially increase the incorporation of ruminal nitrogen into microbial protein and increase the efficiency of nitrogen utilization in the rumen (Bowman and Sanson, 1996). A study conducted by Orr et al. (2008) exhibited greater fiber digestibilities for soybean hull pellets as opposed to corn when fed as a supplement to bermudagrass [*Cynodon dactylon* (L.) Pers.] hay, indicating that supplementing a ruminally available fiber source may replace corn as an energy

supplement for cattle. Rude et al. (2002) supplemented corn or hay to cattle consuming fresh annual ryegrass, and analyzed growth performance and nutrient utilization. In terms of performance, hay supplementation increased ADG compared to the corn. For nutrient utilization, protein digestibility decreased for cattle fed the corn supplement. From this study it was concluded that hay can be utilized as a supplement. Based on the previous studies, the two supplements chosen for the present study were soybean hull pellets and hay. Soybean hull pellets decrease negative associative effects seen when feeding corn as a supplement such as decreased feed intake. Hay is thought to increase digestibility of forage due to a slowed rate of passage through the animal.

The objectives for the study were to:

1) Evaluate the digestibility and utilization of nutrients by steers consuming diets composed of annual ryegrass baleage, and
2) Evaluate nutrient utilization of two different fiber sources on an annual ryegrass baleage diet.

Procedures

All procedures were approved by the Institutional Animal Care and Use Committee of Mississippi State University IACUC # 12-081.

Cattle

Twelve crossbred steers (initial BW 545 ± 45.8 lb) were utilized for the trial. The steers received ad libitum access to annual ryegrass baleage (*Lolium multiflorum*) and were allotted to 1 of 3 treatments: 1) no supplement (NS); 2) bermudagrass hay (H); 3) soybean hull pellets (SBH). Supplements were fed daily at 0.25% of the steers' body weight. Nutrient composition of baleage and supplements used are presented in Table 1. Body weights were taken two consecutive days prior to steers being placed in metabolism crates to determine amount of supplement to be fed to steers on supplement treatments. Prior to steers being placed in the metabolism crates, there was a 14-day adaptation period at which time steers were allowed to become acclimated to the annual ryegrass baleage diet. Steers were also halter broken and tamed at this time in preparation for being handled closely and their confinement period in the crates. After the 14-day adaptation period to the diet, steers were placed in individual metabolism crates for a total of 10 days to facilitate collection of urine and feces during the metabolism trial. The first 3 days were an adaptation period to the crates, with adaptation determined on intake. A 7-day collection period began following the 3-day crate adaptation.

During the 7-day collection period, ORTs were taken up at 6:00 a.m., and steers on supplement treatments were presented their supplement to consume while samples were being taken. Once all samples were collected and steers on supplement treatments had consumed their supplement, all steers were allowed ad libitum access to annual ryegrass baleage until 6:00 a.m. the next morning. All samples were composited by steer for the 7-day collection period. Feedstuff and ORTs samples were taken as hand grab samples. Total fecal output was weighed, and a 5% sample was taken. Urine was acidified 2% using 25% metaphosphoric acid. Total urine output was estimated; 1 to 1.5% acid was added to the collection bucket and then equalized to 2% when total volume of urine

output was collected and measured. A 5% sample of total urine output was collected. Samples were dried in a 60ºC forced-air oven and ground using a Wiley mill using a 2-mm screen. Proximate analysis was run on feedstuffs, ORTS, and feces collected. Protein analysis was run on urine samples using Kjeldahl nitrogen.

Table 1. Nutrient Composition of Feedstuffs

Feedstuff	DM%	OM%	Protein %	NDF%	ADF%	HC%*	Fat%
Ryegrass	50.9	91	16.6	55.8	31.2	24.5	10.9
Hay	91.9	92.9	7.8	71.3	33.4	37.8	5.9
Hulls	90.1	94.9	12.8	62.9	44.6	18.3	15.3

Statistical Analysis

Data were analyzed as a completely randomized design using the GLM procedures of SAS. Steer was the experimental unit. When significant, means were separated using Fisher's LSD. Significance was declared at $P < 0.05$.

Results

Body weight and dry matter intake data are presented in Table 2. Dry matter intake on a lb/day basis was different (P = 0.0212) among treatments. Steers fed NS (8.3 lb/day) and H (8.7 lb/day) consumed less than those fed SH (10.5 lb/day). However, when DMI was calculated as a percent of body weight there was no difference (P = 0.1917) ranging from 1.5 to 1.8% BW/day. Body weight was calculated as an average of the initial body weight taken prior to steers being placed in the metabolism crates and a final body weight taken when steers were removed from the crates.

Table 2. Body Weight and Dry Matter Intake

Dietary treatment	Steer BW, lb	DMI, lb/day	DMI, % BW/day
No Supp.	542.1	8.3[a]	1.55
Hay	531.8	8.7[a]	1.64
Hulls	562	10.56[b]	1.87
P-value	0.6831	0.0465	0.4146

Apparent digestibility data are presented in Table 3. Apparent digestibility of dry matter (DM) was not different (P = 0.7962) and ranged between 67 and 69%. There was no difference for apparent organic matter (OM) digestibility (P = 0.7998), which ranged from 70 to 71%. Apparent crude protein (CP) digestibility did not differ (P = 0.3965) and ranged from 53 to 58%. No difference was found for apparent NDF digestibility (P = 0.6401) with a range from 74 to 76%. There was no difference for apparent ADF digestibility (P = 0.6401) which ranged from 73 to 76%. Apparent hemicellulose digestibility did not differ (P = 0.6297) and ranged from 75 to

77%. Apparent fat digestibility was not different (*P* = 0.3096) among dietary treatments, with a range between 72 to 76%.

Amount of protein retained was not different (*P* = 0.7322) and ranged between 0.4021 to 0.6984 oz. Protein retained was calculated based upon fecal and urine output of protein. The values for treatments in protein are less than what is expected for steers in this body weight range. This is likely due to the fact that the steers were not gaining weight during the study. Protein retention data are presented in Table 4.

Table 3. Apparent Digestibility, %

Treatment	DM%	OM%	ASH%	CP%	NDF%	ADF%	HC%	FAT%
No Supp.	67.64	70.24	39.78	53.30	74.64	73.21	76.51	72.98
Hay	68.88	71.37	42.49	58.36	74.83	74.65	75.05	73.83
Hulls	69.18	71.66	42.10	55.55	76.55	76.11	77.12	76.66
P-value	0.7962	0.7998	0.8210	0.3965	0.6401	0.5204	0.6297	0.3096

Table 4. Protein Retained

Treatment	Protein retained, oz/day
No Supp.	11.4
Hay	19.8
Hulls	17.4
P-value	0.7322

In this study, intake did not differ among treatments, and there was no difference in apparent digestibility among treatments. Thus, there was no effect of supplementing a fiber source to cattle consuming an annual ryegrass baleage diet. Further, in vitro studies are currently being conducted to determine rate of digestibility for the supplements given in the study as well as the annual ryegrass baleage that was fed during the trial.

Implications

Though the data did not show an effect of supplement a fiber source to cattle consuming annual ryegrass baleage, the fact that there was not a negative effect could be of use to producers. Producers feeding out annual ryegrass baleage to cattle can supplement baleage with a cheaper fiber source such as low-quality hay without affecting the nutrient utilization of the baleage to the cattle, allowing the producer to feed less baleage over a given period.

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Selenium-Enriched Probiotics Improve Antioxidant Status and Immune Function of Piglets Raised in a High-Temperature Environment

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Research Summary

The objective of this study was to investigate the effects of selenium-enriched probiotics (SP) on the antioxidant status and immune function of piglets raised in a high-temperature environment. Forty-eight crossbred weaning piglets were randomly assigned to 4 treatment groups and fed *ad libitum* for 42 days a basal diet (Con, 0.16 mg Se/kg), or a basal diet supplemented with probiotics (P, 0.16 mg Se/kg), sodium selenite (SS, 0.46 mg Se/kg) or SP (0.46 mg Se/kg). Three piglets were randomly selected from each group for blood sample collection on days 0, 14, 28 and 42 and for liver, kidney and spleen sample collection on day 42 post-feeding. The results of the sample analyses showed that dietary supplementation of SS and SP (but not P alone) increased the whole blood GPX activity by 40.1% and 69.3%, respectively. Dietary supplementation of P, SS and SP also increased the serum SOD activity (by 40.1%, 53.0% and 64.5%, respectively), the erythrocyte GSH content (by 84.6%, 104% and 165%, respectively), the TCR-induced T lymphocyte proliferation (by 20.8%, 26.4% and 50.0%, respectively), the serum IL-2 concentration (by 24.9%, 27.2% and 46.2%, respectively), and decreased the serum MDA content (by 25.1%, 26.3% and 49.3%, respectively). Since the SP supplementation has the greatest effects on these parameters, it can be concluded that the SP product used can serve as a new or better feed additive for piglets in high-temperature environments.

Introduction

High temperature is considered as a major factor that affects animal health, especially, during the summer. In recent years the global warming climate change seems to exacerbate this situation. The heat stress in pigs not only diminishes animal performance (Lucas et al., 2000) but also has other detrimental effects, such as the reduction in animal antioxidant capacity and immunity (Ju et al., 2011).

Selenium (**Se**), an essential trace element nutrient, plays a critical role in animal redox regulation, antioxidant defense (Burk, 2008) and immune function (Francesconi and Pannier, 2004). Dietary Se supplementation can improve antioxidant defense (Ghazi et al., 2012) and immunocompetence (Niu et al., 2009) of broilers, reduce the negative effects on immune and physiological responses in sheep (Alhidary et al., 2012) and enhance selenoprotein gene expression in young pigs under heat stress (Zhou et al., 2009). In terms of growth performance, meat quality, and antioxidant property, it has been

reported that organic Se has better effects than inorganic Se (Yang et al., 2012).

Probiotics (**P**) are nonpathogenic microorganisms that resist normal intestinal digestion and reach the colon alive, where they exert positive effects on host health (Musa et al., 2009). Previous studies have demonstrated that *Lactobacillus acidophilus* and *Saccharomyces cerevisiae* both as probiotic strains have antioxidative and immunity enhancing effects, and can inhibit lipid peroxidation in pigs under normal conditions (Zhang et al., 2008; Lessard et al., 2009).

A newly developed Se-enriched probiotics product (**SP**), produced in our laboratory by culturing *L. acidophilus* and *S. cerevisiae* under an appropriate micro-conditions with sodium selenite (**SS**, an inorganic form of Se) being added into the culture medium, may serve as a better feed additive. The strains of *L. acidophilus* and *S. cerevisiae* both have ability to efficiently transform inorganic Se into organic Se (Pan et al., 2011; Ren et al., 2011). Previous studies of dietary SP supplementation for livestock, poultry, and mice have demonstrated that the SP has additive beneficial effects resulting from both Se and P (Pan et al., 2011). However, till today no research has been conducted concerning the effects of SP on piglets raised in high-temperature environments. The objective of this study, therefore, was to investigate the effects of dietary SP supplementation on the antioxidant status and immune function of piglets raised in a high-temperature environment.

Procedures

The P, SS, and SP Products

Both P and SP products, provided by our laboratory in Nanjing Agricultural University (Jiangsu, China), contain two probiotic strains, *L. acidophilus* and *S. cerevisiae*. The CFU of *L. acidophilus* and *S. cerevisiae* in both products were approximately 10^{11}/mL and 10^{9}/mL, respectively. The SS used in this study was purchased from Sigma, and the total Se content in the SS stock solution was 100 mg/L. The total Se content in SP product was 10.0 mg/L, with over 90% being organic Se and over 75% being selenomethionine.

Experimental Design and Animal Trial

A total of 48 crossbred [(Landrace × Yorkshire) × Duroc] castrated male weanling piglets (4 weeks old, BW 7.9 ± 0.5 kg), randomly allotted into 4 experimental groups of 12 head in each, were randomly assigned to 4 dietary treatments: To the control (**Con**) group, a normal basal diet (Table 1) containing 0.16 mg total Se per kilogram of diet was fed. To the second (**P)** group, the basal diet supplemented with P was fed. The level of P supplemented were 3×10^{11}/mL and 3×10^{9}/mL of CFU per kilogram of diet for *L. acidophilus* and *S. cerevisiae*, respectively. To the third (**SS)** group, the basal diet supplemented with 0.3 mg Se (from SS) per kilogram of diet was fed. To the fourth (**SP**) group, the basal diet supplemented with 0.3 mg Se (from SP) per kilogram of diet was fed. The level of P supplied in the SP group is equal to that in the P group. The final total Se concentrations in both the SS- and the SP-supplemented diets were 0.46 mg/kg.

The animal trial, lasted for a total of 42 days, was conducted at Bangcheng

Swine Farm located in Xinghua City, Jiangsu Province, China. During the first 33 days, the temperature in the pig shed ranged between 25 and 38°C from 12:00 to 8:00 p.m., and during the last 9 days, ranged between 31 and 40°C from 12:00 to 8:00 p.m. The daily average temperature from 12:00 to 8:00 p.m. at the 42-day period is shown in Figure 1.

All the diets for the piglets were replenished daily and fresh water was accessible all the time throughout the trial. The experimental protocol was approved by the Committee for the Care and Use of Experimental Animals of Nanjing Agriculture University.

Sample Collection and Preparation

On days 0, 14, 28 and 42, three piglets were randomly selected from each treatment groups for blood sample collection at 2:00 to 4:00 p.m. Approximately 5 mL of blood was collected via precaval vein of each piglet using a syringe primed with EDTA, and another 5 mL of blood was collected in a syringe without anticoagulant. All the blood samples were gently ejected into 10-mL Eppendorf tubes individually. Portion of EDTA-primed blood from day 42 was stored at 37°C for T lymphocyte proliferation assay.

To prepare erythrocyte lysates, Eppendorf tubes containing 1 mL blood samples were centrifuged at 3000 rpm for 10 minutes, and the resulting erythrocytes were washed 3 times with physiological saline, re-suspended in 4 mL ice-cold distilled water, shaken vigorously, and then centrifuged at 3,000 rpm for 10 minutes to obtain supernatants as the erythrocyte lysates required.

To obtain serum samples, 5 mL of individual blood sample without anticoagulant was kept in a slanting position at 37°C for 2 hours, and then at 4°C overnight, followed by centrifugation at 3,000 rpm for 15 minutes. The resulting supernatant was the serum samples required. All serum samples were stored at −20°C until analyses of GPX activity, glutathione (**GSH**) content, superoxide dismutase (**SOD**) activity, malondialdehyde (**MDA**) content, and IL-2 concentration.

At the end of the experiment, 3 piglets from each group were randomly selected and euthanized. A half of spleen from each pig was harvested and stored at 37°C until isolation of primary porcine splenocytes for T lymphocyte proliferation analysis. The lymphocytes of both spleen and peripheral blood were isolated using a Commercial Lymphocyte Separation Medium (Chinese Academy of Medical Sciences, Tianjin, China).

Laboratory Analyses

The GPX activity in whole blood, the GSH content in erythrocytes, the SOD activity and MDA contents of serum were respectively determined using corresponding commercial kits (Jiancheng Bioengineering Institute, Nanjing, Jiangsu, China) in accordance with the manufacturers' instructions. One unit (**U**) of GPX activity was defined as 1 μmol of NADPH oxidized per minute, and the activity of GPX in whole blood was expressed as U/L..

The T lymphocyte proliferation induced by T-cell receptor (**TCR**) was analyzed using a WST-8 Cell Counting Kit-8 (Beyotime, Jiangsu, China) according to the

manufacturer's instructions (Zhang and Sun, 2010).[19] The serum IL-2 concentrations were measured using a commercial porcine IL-2 ELISA kit (YuanYe Biotechnology Co., Shanghai, China) according to the manufacturer's protocol, and the results were expressed as pg/mL.

Statistical Analysis

Data were analyzed using one-way ANOVA model followed by Duncan's multiple range tests to separate the means (SPSS computer program for Windows, version 17.0). The *P*-values of less than 0.05 were considered significant.

Table 1. Composition of the Basal Diet

Ingredients[1]	Content, g/kg
Corn	620
Extruded full-fat soybean	280
Whey	50.0
Lysine	10.0
Methionine	3.80
Tryptophan	2.90
Threonine	8.40
Salt	4.00
$CaHPO_4$	6.40
$CaCO_3$	4.00
Trace mineral premix[2]	10.0
Vitamin premix[3]	0.50

[1]Analyzed Se concentration in the basal diets was 0.16 mg/kg.
[2]Trace mineral premix provided per kilogram of diet: iron, 100 mg; copper, 10.0 mg; manganese, 40.0 mg; zinc, 100 mg; selenium, 0.10 mg; iodine, 0.50 mg.
[3]Vitamin premix provided per kilogram of diet: retinyl acetate, 3.03 mg; a-tocopheryl acetate, 32.0 mg; menadione, 2.00 mg; thiamin, 4.00 mg; riboflavin, 14.0 mg; calcium pantothenate, 40.0 mg; niacin, 60.0 mg; pyridoxal, 6.00 mg; d-biotin, 0.20 mg; folacin, 1.20 mg; cobalamin, 0.07 mg.

Results

As shown in Table 2, the GPX activities of the whole blood on day 0 showed no difference among the 4 treatment groups. On days 14, 28 and 42, the GPX activities in the P group were not higher than that in the Con group, but the significant increases ($P < 0.05$) were observed in the SP and SS groups when compared to the Con group. The GPX activity in the SP group was further significantly higher ($P < 0.05$) than that of the SS group.

As shown in Table 3, there were no differences in the erythrocyte GSH contents among the 4 groups on day 0. On days 14, 28 and 42, the GSH contents in the P, SS, or SP group were significantly enhanced ($P < 0.05$) as compared to the Con group. However, between the P and SS groups there was no difference in the GSH contents. The GSH contents in the SP group were higher ($P < 0.05$) than that of the P or SS group on days 14, 28, and 42.

Table 2. The GPX Activity of Whole Blood (U/L)[1]

Group	Day 0	Day 14	Day 28	Day 42
Con	117 ± 3.22a	112 ± 2.36a	109 ± 5.43a	111 ± 4.72a
P	114 ± 4.47a	117 ± 3.89a	121 ± 3.22a	121 ± 2.68a
SS	115 ± 4.09a	147 ± 3.09b	155 ± 4.73b	163 ± 5.58b
SP	116 ± 4.97a	182 ± 2.68c	188 ± 4.64c	192 ± 3.57c

[1]The GPX activities in whole blood (U/L) of piglets fed with the basal diet (Con group), the basal diet supplemented with probiotics (P group), the basal diet supplemented with sodium selenite (SS group), and the basal diet supplemented with selenium-enriched probiotics (SP group). Data presented are mean ± SE (n = 3). Within a column the means followed by different letters differ ($P < 0.05$).

Table 3. The GSH Content of Erythrocytes (μmol/g protein)[1]

Group	Day 0	Day 14	Day 28	Day 42
Con	17.4 ± 1.93a	18.5 ± 1.95a	20.2 ± 1.85a	21.2 ± 1.97a
P	16.0 ± 2.30a	31.3 ± 2.05b	39.1 ± 2.30b	40.5 ± 2.55b
SS	18.4 ± 1.90a	33.5 ± 1.59b	43.6 ± 2.75b	45.4 ± 1.92b
SP	17.3 ± 2.06a	44.9 ± 1.97c	56.6 ± 2.10c	57.9 ± 2.14c

[1]The GSH contents in erythrocytes (μmol/g protein) of piglets fed with the basal diet (Con group), the basal diet supplemented with probiotics (P group), the basal diet supplemented with sodium selenite (SS group), and the basal diet supplemented with selenium-enriched probiotics (SP group). Data presented are mean ± SE (n = 3). Within a column the means followed by different letters differ ($P < 0.05$).

As shown in Table 4, there were no differences in the serum SOD activities among the 4 groups on day 0. On days 14, 28 and 42, the SOD activities in the P, SS, or SP group increased ($P < 0.05$) when compared to the Con group. There are no significant differences in SOD activities between the SS and P or between the SP and SS groups. However, the SP group showed a further increase ($P < 0.05$) when compared to the P group.

As shown in Table 5, there were no differences in the serum MDA contents among the 4 groups on day 0. On days 14, 28 and 42, the MDA contents in the P, SS, or SP group decreased ($P < 0.05$) as compared to the Con group. However, there was no difference in the MDA contents between the SS and P groups. The SP group showed a further decrease ($P < 0.05$) in the MDA content when compared to the SS or P group.

The TCR-induced T lymphocyte proliferation in the peripheral blood lymphocytes and the splenocytes from the 4 treatment groups on day 42 are shown in Figure 2. When compared to the Con group, significant promotions ($P < 0.05$) were observed in the TCR-induced T lymphocyte proliferations in both tissues in the P, SS and SP groups. There was no difference in promoting T lymphocyte proliferation in both tissues between the P and SS groups; however, a significant promotion ($P < 0.05$) was observed in either tissue between the SP and P or between the SP and SS groups.

Table 4. The SOD Activity in Serum (U/mL)[1]

Group	Day 0	Day 14	Day 28	Day 42
Con	106 ± 4.61a	96.3 ± 4.44a	105 ± 2.54a	102 ± 4.24a
P	108 ± 5.03a	131 ± 6.27b	142 ± 5.71b	152 ± 5.89b
SS	107 ± 3.66a	143 ± 3.96bc	155 ± 5.63bc	166 ± 3.38bc
SP	106 ± 3.52a	155 ± 3.56c	170 ± 3.22c	174 ± 3.26c

[1]The SOD activities in serum (U/mL) of piglets fed with the basal diet (Con group), the basal diet supplemented with probiotics (P group), the basal diet supplemented with sodium selenite (SS group), and the basal diet supplemented with selenium-enriched probiotics (SP group). Data presented are mean ± SE (n = 3). Within a column the means followed by different letters differ ($P < 0.05$).

Table 5. The MDA Content in Serum (nmol/mL)[1]

Group	Day 0	Day 14	Day 28	Day 42
Con	2.59 ± 0.17a	4.12 ± 0.21a	4.14 ± 0.13a	4.24 ± 0.10a
P	2.69 ± 0.10a	3.02 ± 0.22b	3.11 ± 0.18b	3.23 ± 0.17b
SS	2.54 ± 0.13a	2.97 ± 0.17b	3.06 ± 0.15b	3.18 ± 0.18b
SP	2.64 ± 0.09a	1.97 ± 0.19c	2.09 ± 0.24c	2.28 ± 0.13c

[1]The MDA contents in serum (nmol/mL) of piglets fed with the basal diet (Con group), the basal diet supplemented with probiotics (P group), the basal diet supplemented with sodium selenite (SS group), and the basal diet supplemented with selenium-enriched probiotics (SP group). Data presented are mean ± SE (n = 3). Within a column the means followed by different letters differ ($P < 0.05$).

The TCR-induced T lymphocyte proliferation in the peripheral blood lymphocytes and the splenocytes from the 4 treatment groups on day 42 are shown in Figure 2. When compared to the Con group, significant promotions ($P < 0.05$) were observed in the TCR-induced T lymphocyte proliferations in both tissues in the P, SS and SP groups. There was no difference in promoting T lymphocyte proliferation in both tissues between the P and SS groups; however, a significant promotion ($P < 0.05$) was observed in either tissue between the SP and P or between the SP and SS groups.

As shown in Table 6, there were no differences in the serum IL-2 concentrations among the 4 groups on day 0. On days 14, 28 and 42, the IL-2 concentrations in the P, SS, or SP group all increased ($P < 0.05$) when compared to the Con group. There was no difference in the IL-2 concentrations between the P and SS groups on days 14, 28, and 42; however, a significant increase ($P < 0.05$) was observed between the SP and P or between the SP and SS groups on either day 14, 28, or 42.

The MDA content manifests the level of lipid peroxidation and represents the level of cell or tissue damage indirectly (Su et al., 2008). The activities of GPX and SOD and the content of GSH represent the competence of animal antioxidant status because these proteins participate in the clearing of the superoxide anion-free radicals in cells to protect cells from damage (Yildiz, et al., 2005; Su et al., 2008). Selenium plays a crucial role in the function of several important enzymes, such as GPX that is involved in animal antioxidant defense mechanisms (Fairweather-Tait et al., 2011). The SS product used this study

improved animal antioxidant status because the SS supplementation increased the GPX activity of whole blood and the SOD activity in serum, increased the GSH content of erythrocytes, and reduced the MDA content in serum as well.

Table 6. The IL-2 Concentration in Serum (pg/mL)[1]

Group	Day 0	Day 14	Day 28	Day 42
Con	102 ± 4.28a	99.3 ± 3.23a	100 ± 2.85a	101 ± 3.33a
P	103 ± 3.54a	122 ± 2.47b	126 ± 3.61b	127 ± 2.47b
SS	97.2 ± 2.93a	124 ± 3.73b	128 ± 3.17b	130 ± 3.06b
SP	100 ± 3.52a	139 ± 3.54c	147 ± 3.07c	153 ± 3.73c

[1]The IL-2 concentrations in serum (pg/mL) of piglets fed with the basal diet (Con group), the basal diet supplemented with probiotics (P group), the basal diet supplemented with sodium selenite (SS group), and the basal diet supplemented with selenium-enriched probiotics (SP group). Data presented are mean ± SE (n = 3). Within a column the means followed by different letters differ ($P < 0.05$)

This study also showed that the dietary P supplementation increased the GSH content and SOD activity, and decreased the MDA content, which suggest that the P product used can improve the antioxidant status of piglets raised in a high-temperature environment.

In comparison with the P or the SS supplementation alone, the SP supplementation further increased the GPX and SOD activities, increased the GSH content, and reduced the MDA content (Tables 3 to 6), which indicate that the SP product used has more robust effects in improving animal antioxidant status than the P or SS product used alone.

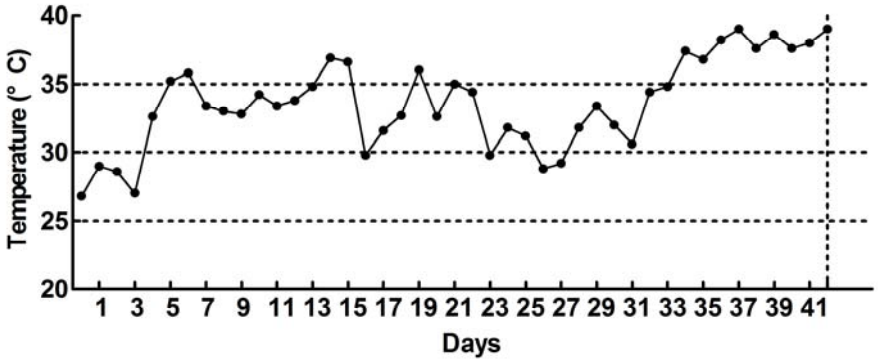

Figure 1 The daily average temperature from 12:00 pm to 08:00 pm over the 42-day experiment period.

T lymphocyte proliferation and IL-2 cytokine secretion play very important roles in animal immune function (Grimble, 1998), and TCR is a mitogen specific to T cell proliferation. Data presented in this paper showed that the dietary P, SS, and SP supplementations promoted TCR-induced T lymphocyte proliferation from both blood and spleen sources and increased the serum IL-2 concentrations. In addition, the

data further showed that the effects of SP supplementation on both lymphocyte proliferation and serum IL-2 concentration were more dramatic than that of P or SS supplementation alone, suggesting that the SP product has additive benefits from Se and P in improving pig immune function.

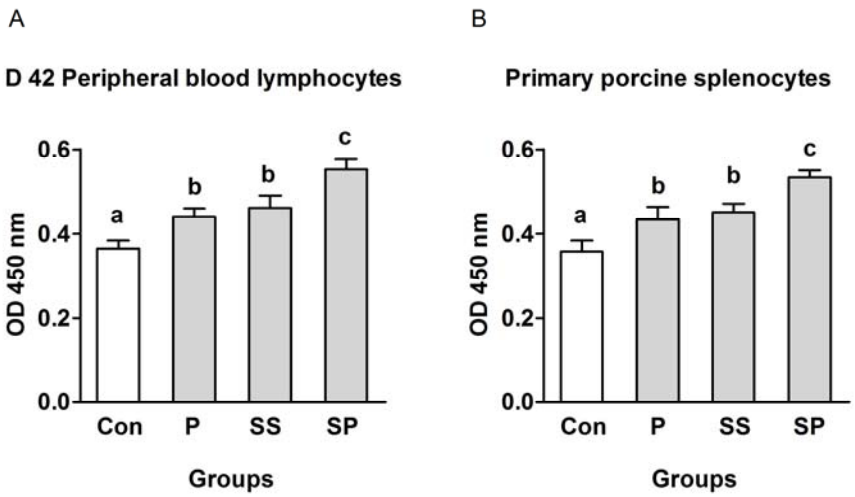

Figure 2. The TCR-induced T lymphocyte proliferation in the peripheral blood lymphocytes (**A**) and splenocytes (**B**) of piglets fed with the basal diet (Con group), the basal diet supplemented with probiotics (P group), the basal diet supplemented with sodium selenite (SS group), and the basal diet supplemented with selenium-enriched probiotics (SP group). Data presented are mean ± SE (n = 3). Within a panel the bars labeled with different letters differ ($P < 0.05$).

Implications

In conclusion, this present study showed that the SP product newly developed in our laboratory has additive beneficial effects of P and Se, and is more effective in improving the antioxidant status and immune function of young piglets than the P or SS product alone, suggesting that this SP product can serve as a new or better feed additive for piglets raised in high-temperature environments.

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Effect of an Electrolyte Supplement Added to Diets of Transition Dairy Cows on Milk Yield, Composition, and Blood Metabolites

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Research Summary

Supplementation with electrolytes during heat stress is a key component to maintaining blood acid-base balance and subsequently supporting milk production. Potassium and Na are the primary cations involved in maintaining this balance, and large quantities of K are lost in heat-stressed dairy cows due to sweating. Electrolyte supplementation could increase (or maintain) DMI and MY in heat-stressed cows by either improving mineral deficiency or maintaining the blood acid-base balance, and it could be difficult to separate the two mechanisms. During the months of August and September, 66 dry, gravid Holstein cows and heifers were fed either a 1) control diet (CON, n = 34) partial mixed ration pre- and post-calving (14 and 25 mEq (K + Na – Cl – S)/100g DM, respectively) containing corn silage, annual ryegrass (*Lolium multiflorum* Lam.) baleage, whole cottonseed, and a concentrate mix, or 2) a treatment diet (Bovine Bluelite) (LYTE, n = 32) pre- and post –calving [17 and 27 mEq (K + Na – Cl – S)/100 g DM, respectively]. In this study, blood mineral concentrations, acid-base balance, DMI, and MY were maintained when cows were fed Bovine Bluelite. No negative effects of adding Bovine Bluelite to the diet were found.

Introduction

In dairy cattle, specifically lactating cows, the dietary cation-anion difference (**DCAD**) was determined to be more important than any individual ingredient (Delaquis and Block, 1995; Chan et al., 2005), source of cations or anions (West et al., 1992), or the concentrations of any individual electrolyte (Tucker and Hogue, 1990; Chan et al., 2005) in terms of increasing milk production, maintaining osmotic pressure, and aiding nerve function. The optimal DCAD for prepartum dairy cows is generally between -5 to -10 mEq/100g DM to help prepare the cow for the negative energy balance associated with the immediate, post-calving period. This range is common,well-defined, and has been shown to reduce the incidence of metabolic disorders post-calving (Horst et al., 1997; Chan et al., 2005). The potential for use of DCAD in early-lactation rations has become the target of increased recent investigation.

Dry cows are often fed diets high in forage, but are quickly switched to diets high in concentrate and energy upon parturition to adjust for the increased energy demands required from the body in the form of drastically increased milk production. However, even this increased energy intake can leave the cow in a negative energy balance and leave her susceptible to multiple metabolic diseases such as acidosis, ketosis, displaced abomasum, or milk fever. The dairy industry has begun to lean more on increasing the DCAD in late lactation to prepare the cow for the physiological

changes her body will endure upon parturition and make dealing with the increased energy demands from lactation and negative energy state associated with it easier on the cow (Bauman and Currie, 1980; Schneider et al., 1988; Chan et al., 2005). Much of this work has been through increased Na and K concentrations in the diet or increased anionic salts (increased Cl and S), which in turn, increase the DCAD in the diet (Block et al., 1984; Schneider et al., 1988; Chan et al., 2005;). Increasing the Na and K concentrations in the diet increases the DCAD through a change in the acid-base chemistry and alkalinity of body fluids such as the blood. This increased DCAD negates acidosis by increasing blood pH and blood bicarbonate (HCO_3^-), and in turn, increasing the buffering capacity of the blood (Block, 1984). A study conducted by Tucker and colleagues (1988a) increased DCAD in increments of 10 from -10 to 20 mEq and found a linear increase in blood HCO_3^- and pH. This increased buffering capacity in the blood led to an increase in DMI and milk yield by 11 and 9% respectively when comparing -10 to 20 mEq.

During heat stress, which is a costly issue in the Southeast, the blood acid-base chemistry in the cow is altered due to the increased loss of Na in the urine and K in the sweat (Schneider et al., 1988; Tucker et al., 1988a), indicating a potential for the cow to benefit from increased DCAD (Escoba et al., 1984; West et al., 1991; West et al., 1992). Increased DCAD during times of elevated temperature can positively affect blood HCO_3^-, DMI, and milk yield (West et al., 1991; Sanchez et al., 1994;). This further confirms the hypothesis that responses to DCAD may differ depending upon climatic and environmental conditions (Chan et al., 2005).

Much data exists detailing the positive effects associated with a negative DCAD pre-calving; and with more and more data available outlining the effects of DCAD alteration in early lactation, the time has come to develop a protocol that can be followed throughout the cow's life cycle (early pre-calving period through peak lactation). Data assessing the efficacy of providing a pelleted electrolyte supplement to dairy cows prior to parturition and follows through the transition period is scarce. The objectives of the current study are to 1) determine the effects of providing an electrolyte supplement (in the form of Bovine BlueLite, TechMix, Inc; Stewart, MN) to pre-and post-partum dairy cows on DMI (pre-fresh), blood chemistry, and milk yields and 2) determine the efficacy of this electrolyte supplementation as a means to alleviate heat stress during the transition period of dairy cows.

Procedures

Animals and Housing

During the months of August and September, 66 dry, gravid Holstein cows and heifers were fed either a 1) control diet (CON, n = 34) partial mixed ration pre- and post-calving (14 and 25 mEq (K + Na – Cl – S)/ 100g DM, respectively) containing corn silage, annual ryegrass (*Lolium multiflorum* Lam.) baleage, whole cottonseed, and a concentrate mix, or 2) a treatment diet (LYTE, n = 32) pre- and post-calving [17 and 27 mEq (K + Na – Cl – S)/100 g DM, respectively]. The treatment diet consisted of the same partial-mixed ration as the control diet with the addition of 6oz/head/day of a pelleted electrolyte top-dressed over the ration (Bovine BlueLite® Pellets, TechMix, LLC; Stewart, MN). Cows started treatment 21 days prior to their

expected calving date. Twenty-four cows were fed treatment diets once daily in Calan Gates (American Calan©, Northwood, NH) at 0600. Cows on each treatment had open access to an exercise lot where one bale of annual ryegrass baleage (approximately 1,200 lb/bale) was placed every other day for unrestricted consumption. Daily measurements included intake, milk yield, and health observations (rectal temperature and respiration rate). Blood was taken via jugular venipuncture weekly as were body weights, frame measurements (withers height, hip height, and heart girth), body condition scores, health observations (respiration rate and rectal temperatures), feed samples, and milk samples. The remaining 50 cows (n = 25) were housed in an adjacent free stall barn and given the same treatments. These cows were treated the same, and identical data were taken from them as the Calan-housed cows, with the exception of individual intake data. All cows from both experiments received their respective diets until calving.

After calving, cows in the Calan gates were moved to the larger free-stall pens with their herd mates and grouped according to treatment. All cows remained on their original treatment (CON or LYTE) until approximately 4 weeks post-calving. Cows were fed 50 lb DM twice daily (25 lb DM per feeding).

Sample Collection and Analysis

Feed samples were subjected to proximate analysis according to Goering and Van Soest (1970) at the Warner Essig Nutrition Laboratory on the Mississippi State University campus. Blood samples were analyzed using an Idexx VetStat Analyzer (IDEXX Laboratories; Westbrook, ME) for pH, pCO_2, HCO_3^-, tCO_2, Anion Gap, Na^+, K^+, and Cl^-. Blood was also analyzed for hematocrit using a micro centrifuge. Upon calving, milk yields were determined; daily and weekly milk samples were collected and sent to Mid-South Dairy Records (DHIA) for analysis of fat, protein, solids-not-fat, lactose, and somatic cell score. Daily intake data were collected during the morning feeding for the cows fed in the Calan gates pre-calving. Weekly respiration rates, rectal temperatures, and body condition scores were taken by the same three trained research assistants. Respiration rate and rectal temperature were taken daily, in addition to weekly, in the afternoon for all cows.

Weather Data

A weather station (Hobo U30/NRC; Onset Computer, Pocasset, Mass.) was placed near the Calan gate barn to measure ambient environmental factors including temperature, relative humidity, solar radiation, precipitation, and wind speed. Mean daily temperature humidity index (THI) was derived from daily means using an equation taken from Mader and associates (2004).

Statistical Analysis

Data for both the dry and lactating cows in this experiment were analyzed using the MIXED procedure in SAS (SAS, 2004). The model terms included cow, week (or day), treatment, THI, and parity. All main effects and interactions were tested. The summer weather during the trial was mild, rendering the effect of THI insignificant ($P > 0.05$), and it was removed from the model statement for the remainder of the analysis. Week (or day) was defined as the week (or day) relative to calving and was used as a repeated

measure when appropriate. Significance was declared at $P < 0.05$, and trends were declared at $P < 0.10$.

Table 1. Ingredients of diets fed to dry and lactating cows with or without electrolytes

Dry Cow Ingredient, %		
	CON	LYTE
Corn silage	42.1	41.6
Annual ryegrass baleage	27.1	26.8
Annual ryegrass hay	0	0
Whole cottonseed	7.49	7.40
Concentrate mix[1]	23.1	22.7
Lactating Cow Ingredient, %		
	CON	LYTE
Corn silage	38.7	38.8
Annual ryegrass baleage	8.16	8.16
Annual ryegrass hay	1.80	1.79
Whole cottonseed	5.48	5.48
Concentrate mix[2]	45.8	45.8

[1]Dry cow concentrate mix included: Wheat midds, 21%; Soybean hulls, 21%; Ground corn, 17%, Cottonseed meal, 13.5%, Soybean meal, 11.3%; Fish meal, 5.2%; Ca Carbonate, 4.83%; Magnesium oxide, 1.35%; Salt, 0.75%; Dical, 0.71%; Vit E 20,000 IU, 0.58%; Se, 0.34%; Zin pro 4 plex, 0.29%; Fat (grease), 0.25%; [2]Lactating cow grain mix included: Ground corn, 40.2%; Soybean meal 48%, 27.7%; Soybean hulls, 16.1%; Wheat midds, 4.71%; Ca Carbonate, 1.96%; Fish meal, 2.35%; Blood meal, 0.78%; Megalac, 0.98%; Poultry meal 0.71%; Salt, 0.57%; Animal Fat, 0.23%; K carbonate, 0.59%; MagOx 54%, 0.47%; Potash,0.39%; Zinpro 4 Plex, 0.11%; MTB-100, 0.13%; Se, 0.02%; Mn, 0.02%; Zn, 0.02%; Co, 0.01%; Cu, 0.01%; Vit A 325, 000 IU, 0.01%; Vit D3 200,000 IU, 0.01%; Vit E, 227,000 IU; 0.014%

Results

Diet and Intake Results

Forage was decreased in the lactating cow diet, and concentrate was added to provide more energy for early lactation (Table 1). In addition, annual ryegrass hay was present in the lactating cow diet, but was not given to the dry cows. Dietary nutrient concentrations were similar for both diets (Table 2). Electrolyte supplementation has been known to increase DMI in previous trials (Chan et al., 2005; Hu et al., 2007), there was a tendency for increased DMI in cows fed CON pre-fresh (30.1 vs. 29.7 lb/day; respectively; $P < 0.09$) in this study. Because cows were housed and fed in pens post-partum, only feed offered was measured; thus, DMI was not reported for lactating cows.

Body Growth and Health Results

Body weight was not different (1154 vs. 1242 lb, respectively; $P = 0.12$; Table 3), nor were withers height, hip height, heart girth, or rectal temperature. There was,

however, a tendency for cows fed the LYTE diet to have decreased respiration rates (54 vs. 51 beats per minute, respectively $P < 0.09$). Body condition score was also different by week ($P < 0.01$), which was expected as cows begin to shed condition after calving as they enter lactation; but no treatment differences were recognized.

Table 2. Concentration of diets fed to dry and lactating cows with or without electrolyte supplementation

Dry Cow Nutrient Composition, %		
	CON	LYTE[1]
DM	50.2	51.0
CP	15.5	15.4
NDF	50.2	49.6
ADF	30.7	30.4
Ca	0.93	0.93
P	0.39	0.39
K	1.24	1.28
Cl	0.48	0.51
Na	0.20	0.26
S	0.21	0.21
Lactating Cow Nutrient Composition, %		
	CON	LYTE
DM	54.7	54.8
CP	17.7	17.6
NDF	39.3	39.1
ADF	23.2	23.1
Ca	0.81	0.81
P	0.39	0.39
K	1.34	1.36
Cl	0.45	0.45
Na	0.44	0.46
S	0.25	0.24

[1]LYTE diet calculations include Bovine BlueLite supplementation at time of analysis

Table 3. Growth and health measures of dry and lactating cows fed diets with or without electrolyte supplementation

	Treatment					
	CON	LYTE	SEM	*P*-value <		
				Treatment	Week	Treatment × Week
Body weight, lb	1154.2	1242.3	112.3	0.12	0.17	0.09
Withers height, in	52.0	51.6	0.36	0.33	0.51	0.82
Hip height, in	54.3	53.9	0.31	0.30	0.93	0.39
Heart girth, in	74.8	75.2	0.62	0.38	0.19	0.28
Body condition score	3.37	3.37	0.03	0.95	0.01	0.54
Respirations, bpm	54	51	1.4	0.09	0.17	0.43
Rectal Temp, °F	101.8	101.8	32.1	0.78	0.42	0.18

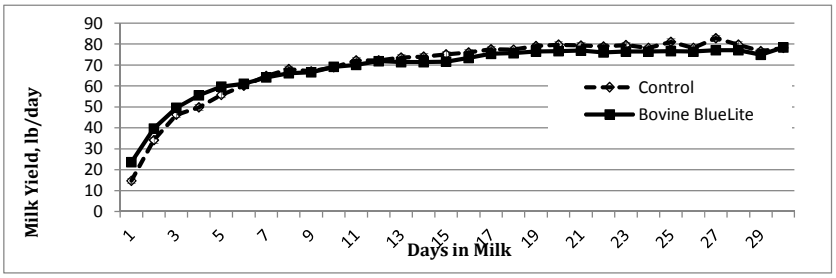

Figure 1. Milk yield relative to calving in lactating cows fed diets with or without electrolyte supplementation

Milk Yield and Composition Data

Overall, no treatment differences were found for milk yield, fat %, lactose %, solids non-fat %, or somatic cell score (Table 4). However, cows fed the electrolyte supplement in both the pre- and post-calving period had a greater milk protein (3.12 vs. 2.89 %, respectively; $P < 0.01$), which directly agrees with another study (Hu et al., 2007) that found a linear increase in milk protein when electrolyte supplementation was increased during early lactation (3.24 vs. 3.11%, respectively; $P < 0.01$). Although milk production was not different in terms of overall production for this trial, further investigation indicated a difference in mean average milk yield by treatment for the first 5 days post-calving (Figure 1). Cows fed the electrolyte supplement during the transition period were able to enter lactation with more persistency and produce more milk than their control-fed herdmates. No differences were found after day 5 post-calving. Milk yields in the current trial were 6 to 8 kg/day greater than reported in the latter studies. It is possible that the effect of the additional electrolyte may be difficult to maintain in high-producing cows. Primiparous cows consuming the CON diet had greater milk production, but that difference was not seen in multiparous

cows (Figure 2). These results indicate that Bovine BlueLite may be able to assist cows during the difficult transition period and may also assist older cows better than newly-fresh heifers.

Table 4. Milk yield and composition for lactating cows fed diets with or without electrolyte supplementation

	Treatment					
	CON	LYTE	SEM	*P*-value <		
				Treatment	Week	Treatment × Week
Milk yield, lb/day	73.3	70.7	2.84	0.51	0.01[1]	0.02[1]
Fat, %	3.41	3.42	0.39	0.98	0.62	0.74
Protein, %	2.89	3.12	0.05	0.01	0.01	0.01
Lactose, %	4.73	4.71	0.06	0.87	0.48	0.12
Solids non-fat, %	8.53	8.70	0.09	0.18	0.01	0.35
Somatic cell score	1.68	1.93	0.13	0.21	0.79	0.29

[1]*P*-value of effect of day and treatment × day for milk yield only.

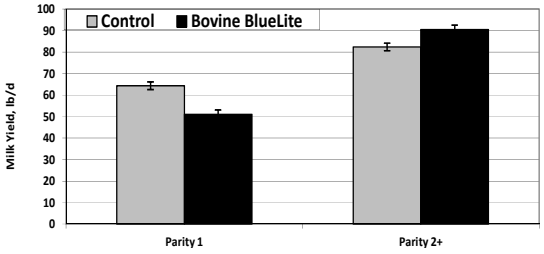

Figure 2. Milk yield by parity and treatment in lactating cows fed diets with or without electrolyte supplementation

Blood Metabolite Results

No treatment differences were noted for blood pH, anion gap, tCO_2, sodium, potassium, chloride, or hematocrit (Table 5). No differences were found for pCO_2 (43.5 vs. 43.4 mmHg, respectively; *P* = 0.75) or HCO_3^- (27.2 vs. 27.2 mmol/L, respectively; *P* = 0.96) when comparing the CON fed cows to the LYTE fed cows. Partial pressure of CO_2 and HCO_3^- are known to play a role in respiration; so the fact that respiration rate was affected, but pCO_2 and HCO_3 were not, is interesting to note.

Table 5. Blood metabolite data pre- and post-calving for cows fed diets with or without electrolyte supplementation

	Treatment					
	CON	LYTE	SEM	*P*-value <		
				Treatment	Week	Treatment × Week
Blood pH	7.44	7.44	0.002	0.58	0.29	0.74
pCO_2, mmHg[1]	43.5	43.3	0.48	0.75	0.01	0.29
HCO_3^-, mmol/L[2]	27.2	27.2	0.31	0.96	0.01	0.19
Anion Gap, mmol/L	13.3	13.5	0.25	0.63	0.01	0.56
tCO_2, mmol/L[3]	28.6	28.5	0.31	0.85	0.01	0.17
Na, mmol/L	142.7	142.8	0.24	0.73	0.01	0.02
K, mmol/L	3.95	3.99	0.04	0.49	0.81	0.09
Cl, mmol/L	106	106	0.22	0.90	0.01	0.69
Hematocrit, %	52.8	51.5	1.06	0.43	0.05	0.86

[1]Partial Pressure of CO_2; [2]Blood Bicarbonate; [3]Total Bicarbonate

Implications

Electrolyte supplementation and DCAD modification has been previously shown to positively and separately benefit both dry and lactating cows (Schneider et al., 1988; Chan et al., 2005; Hu et al., 2007). This study further indicates the potential benefits of electrolyte supplementation during the difficult and crucial transition period. By providing an electrolyte supplement during the transition period, the opportunity exists to better prepare dry cows for the intense demands and changes that come with parturition and the onset of lactation. This opportunity is well illustrated during the persistence of production in the first 5 days for the cows fed the LYTE treatment. In addition, heat stress was not as severe as anticipated during this study; further research under more severe heat stress would determine the impact of supplementing electrolytes to lactating cows.

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Translation of Aflatoxin into the Milk of Lactating Dairy Cows Fed an Anti-Caking Agent

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Research Summary

Aflatoxin contamination of dairy feed is a serious concern for dairy producers. Since up to 70% of the aflatoxin found in the diet (AFB_1) could be transferred into the milk (AFM_1) making that milk non-saleable, contamination of feed can pose a severe economic drain on dairy producers. Given the widespread drought conditions across the U.S. this year, aflatoxin contamination in corn grains is expected to be highly prevalent and as such most buyers of milk have increased their testing requirement. Some research has been done to utilize adsorbents in the diet to 'bind' the aflatoxin. However, the results are very conflicting and change with dietary concentrations, rate of intake, and stage of milk production. Twelve multiparous Holstein cows were fed either a control TMR (CON, 10 ppb AFB_1), the control TMR with addition of AFB_1 infected corn (AF, 37.5 ppb AFB_1), or the AF TMR with the addition of an anti-caking agent (AF+G, 47.5 ppb AFB_1). Cows were fed individually in a Calan Gate System (American Calan, Northwood, NH), twice daily for a total of 30 days. Feed (DM) intake and milk yield were collected daily. Body weights and measures and milk samples were collected weekly. Feed and orts samples were analyzed for dry matter, total Kjeldahl nitrogen, NDF, ADF, ash, fat, and AFB_1 concentrations (Veratox, Neogen Corp, Lansing, MI). Milk samples were analyzed for fat, protein, SCC, and AFM_1 (GC/MS). Cows consuming AFB_1 had greater concentration of AFM_1 in their milk, specifically; cows fed the adsorbent had the greatest concentration of AFM_1 in their milk. Milk yield was also lower in cows fed AFB_1, where cows fed the adsorbent also had the lowest milk yield.

Introduction

Several approaches have been utilized in an attempt to reduce the impact that aflatoxin has in the livestock industry, and subsequently on human health (Jouany, 2007). These approaches include biological (various additives), chemical (solvent extraction and ammoniation), and physical (physical removal of infected kernels and dilution) treatment of feedstuffs (Masoero et al., 2009). Physical modification of aflatoxins can minimize production of the toxin and sometimes even eliminate the contaminant all together (Firmin et al., 2011). However, Oluwafemi (2004) only found up to a 20% decrease of the aflatoxin B_1 content in grains when they were heated to 100°C and left there for 30 minutes. Another alternative is to biologically or chemically modify aflatoxins through the addition of commercially available feed supplements known as sequestering agents. Many sequestering agents exist for purchase by producers in the form of activated carbons, bentonites, zeolites, aluminosilicates, and esterfied

glucomannans (derived from the yeast cell wall), but are not extensively applied due to their cost and unknown efficacy (Niderkorn et al., 2007; Diaz et al., 2004; Diaz et al., 2002). Sequestering agents are commonly referred to as binding agents, clay binders, or anti-caking agents as they often bind to the aflatoxin in the feed and restrict the bioavailability of the toxin (Frimin et al., 2011), protecting numerous species from the toxic effects of aflatoxin B_1 (Ramos et al., 1996). In order for a sequestering agent to be effective, it must tightly bind with the aflatoxin in the feed without being damaged or dissociating in the harsh conditions of the digestive tract within the animal. If this occurs, the toxin-binder complex will pass through the digestive tract and be successfully excreted in the feces, preventing or minimizing the animal's exposure time to the carcinogen (Diaz et al., 2002). The use of use of yeast cell wall derivatives in the form of esterifed glucomannans has drawn much attention lately due to their organic nature and their potential to bind multiple different aflatoxins within the feed (Firmin et al., 2011). However, the efficacy of these sequestering agents in vitro may not adequately predict its effectiveness in vivo (Diaz et al., 2004; Lemke et al., 2001). To the best of our knowledge, many of the studies involving the effects of yeast cell wall extracts on mitigating the effects of aflatoxin on dairy animals have been done in species other than dairy cows, and experiments which did utilize dairy cows have utilized non-direct markers (weight loss, dry matter intake, onset of toxicity, blood parameters) to determine the effects of aflatoxin with in the dairy cow (Diaz-Llano and Smith, 2006; Shetty and Jesperson, 2006; Chowdhury et al., 2005; Diaz et al., 2004; Yiannikouris et al., 2004). Even less work has been done to determine the effects of sequestering agents on aflatoxin excretion in the milk of the lactating dairy cow. Therefore, the objective of the current study is to determine the effect of supplementing a yeast cell wall extract (MTB-100, Alltech, Inc, Lexington, KY) in the diet of lactating Holstein cows on overall health, performance, and excretion in the milk.

Experimental Design

Care and use of animals used in this trial were conducted in accordance with and under the approval of the Institutional Animal Care and Use Committee of Mississippi State University. During the months of October and November, 12 mid-to-late lactation Holstein cows were randomly assigned to one of 3 experimental treatments: 1) a standard corn silage based TMR (**CON**, n=2), 2) CON with the addition of aflatoxin B_1(**AFB_1**) (**AF**; 50 ppb, n= 5), or 3) AF with the addition of an esterified glucomannan composed of yeast and silicates (MTB-100; Alltech, Inc., Nicholasville, KY; **AF+G,** n= 5). All diets were mixed in a Data Ranger mixer wagon (Data Ranger, American Calan®) in the following order: 1) CON, 2) AF, and 3) AF+G, to help negate any cross contamination. Cows were housed in a free stall barn and fed through Calan gates (American Calan®) where they were allowed a 10 day acclimation period, and then fed their assigned diets for 4 weeks. Cows were fed and milked 2x daily. Prior to the first feeding of the trial, a blood sample was taken via jugular venipuncture and body weights were recorded to set baseline values. Daily measurements included milk production and dry matter intake. Weekly samples included blood samples, body weight, hip and withers height, hip width,

milk samples, and feed and ort samples. Milk efficiency was also determined (kg milk produced/ kg feed consumed). Milk samples were analyzed for aflatoxin M1 concentrations (**AFM_1**).

Feed and Ort Sample Collection and Analysis

Feed and ort samples were collected once weekly and ground to pass through a 2-mm screen using a Thomas Wiley Mill® (Arthor H. Thomas, Philadelphia, PA). Samples were analyzed to determine values for dry matter, ash, neutral detergent fiber, acid detergent fiber, fat, and crude protein according to procedures defined by Goering and Van Soest (1970).

Aflatoxin Analysis

A subsample of each feed sample was extracted with 50 ml of a 70% methanol solution using a 250 ml beaker and Whatman Number 1, 185 mm filter paper until dripping ceased. Extracted liquid was stored at 4°C for later analysis.

Extracted liquid samples were analyzed for aflatoxin content using the Veratox Aflatoxin Quantitative Test (Neogen Corporation; Lansing, MI). Veratox is a direct competitive immunoassay that uses antibody coated wells to check samples for aflatoxin. An enzyme labeled aflatoxin conjugate competes with the free aflatoxin from the sample for the antibody binding sites. Conjugate is added to the mixture and reacts with the bound conjugate to produce a blue color. 100 µL of conjugate and sample are each added to the mixing well. The mixture is then added to the antibody coated well for 2 minutes. The wells are washed out with deionized water following the 2 minutes. Substrate is then added to bind to the already bound conjugate producing a blue color. The more intense the blue color, the less aflatoxin in the sample. The amount of aflatoxin is calculated by a Neogen microwell reader. The results were obtained by analyzing the wells' absorbance at 650nm and by comparing that to the standard curve. Samples where $r < 0.98$ were repeated to ensure accuracy.

Milk samples were also analyzed for aflatoxin M_1 content in triplicates. Sample aliquots of 25 mL were extracted with 3 X 50 mL of chloroform (150 mL total) in a separatory funnel. The organic phase was collected and the chloroform was evaporated using nitrogen. The sample was then reconstituted in 1 mL of acetonitrile and filtered prior to liquid chromatography (HPLC) analysis.

For quantitative estimation of AFM_1, measurements were performed on a Dionex Ultimate 3000 HPLC system coupled to a Bruker Amazon SL ion trap mass spectrometer using an electrospray ionization interface. HPLC separation was performed using Phenomenex Kinetex -C_{18} 4.6 x 150 mm (2.6 µm) analytical column. Mobile phase A consisted of water, 5 mM of ammonium acetate, and 0.1% formic acid while mobile phase consisted of methanol with 5 mM ammonium acetate and 0.1formic acid. The solvent gradient began at 50% Solvent A and changed to 5% B over a 2-minute period and was held at that condition for 1.5 minutes until changing back to initial solvent conditions. Total analysis time was 8 minutes.

Statistical Analysis

This experiment utilized a completely randomized design when assigning animals to treatments (main effect = dietary treatment) with treatment (CON, AF, AF+G), week, and lactation group as the class variables with all possible interactions examined by ANOVA using the GLM procedure of SAS (SAS, 2004).

Significance was declared at $P < 0.05$ and tendencies were declared at $P < 0.10$.

Feed Composition and Intake

Nutrient content (DM, CP, NDF, ADF, Fat, Ash) was similar for all treatments (Table 1). Although aflatoxin concentrations (ppb) were greater in the AF and AF+G diets, aflatoxin was also found in the CON diet. Dry matter intake was not different when diets were contaminated or with the addition of the sequestering agent (Table 2). We expected to find a decrease in DMI when aflatoxin contamination was increased in the diet followed by a subsequent increase in DMI when a sequestering agent was added to the diet, similar to that of other studies conducted (Stroud, North Carolina State Univ., Raleigh, NC, MS Thesis), but this agrees with another study (Masoero et al., 2009) that did not find DMI differences when a clay sequestering agent was added to an aflatoxin contaminated diet (52.4 vs. 51.2 lb/day, respectively; $P = 0.67$). CP and NDF intake were greater in cows fed AF+G compared to both CON and AF ($P < 0.05$). ADF intakes were also different, cows fed AF had the greatest ADF intake, followed by cows fed AF+G and cows fed CON had the lowest ADF intake. Aflatoxin B_1 intake was different for each treatment, as expected, with the CON fed cows consuming the least aflatoxin (11.7 ppb/day; $P < 0.01$). As expected, AFB_1 intake increased when cows were fed AF but because of increased concentration of AFB_1 in the AF+G diet, which was contrary to expectations, intake of AFB_1 increased even more when cows were fed AF+G (38.4 vs. 51.7 ppb/day, respectively; $P < 0.01$). Analysis of individual feed ingredients revealed 0.4 ppb of AFB_1 in the sequestering agent. This particular sequestering agent used DDG as a carrier and it is possible that the DDG were the source of AFB_1. Cows were fed in the same order: CON, AF, then AF+G. Although cleaning occurred between each treatment, cleaning may not have been adequate enough to remove all aflatoxin B_1 from the feed wagon, which may have increased aflatoxin B_1 contamination in the AF+G diet, leading to the increased aflatoxin B_1 intake for the cows on that treatment. Aflatoxin contamination can spread and pose a threat to multiple facets on any operation, which is further indicated by this trial, showing that proper and thorough care must be used to reduce the contamination on the farm and from operation-to-operation.

Milk Yield, Weight, and Frame Data

Milk yield and feed efficiency were more than 25% and 30% lower, respectively, in cows fed AF+G when compared to cows fed CON and AF ($P < 0.01$;Table 2), but the latter were not different from each other. This agrees with a study conducted in dairy ewes that found that feeding aflatoxin contaminated feed with and without a binding agent did not change milk production (4.5 vs. 3.7 vs. 4.9 ga/day, respectively; $P = 0.22$; Firmin et al., 2011) and also agrees with a study conducted in dairy cattle indicating that the addition of a sequestering agent to contaminated feed had no effect of milk production (68.2 vs. 73.1 lb/day, respectively; $P = 0.38$). However, other studies have found that feeding Aflatoxin (Veldman et al., 1992; Applebaum, 1982) Body weight was decreased in animals fed contaminated feed to cattle reduces milk yield within 24 hours of consumption the CON diet compared to AF and AF+G (1275 vs. 1453 and 1649 lb, respectively; $P < 0.01$; Table 3), Cows fed AF+G had greatest overall BW, but it is unlikely that this result

Table 1. Ingredients, nutrient composition and Aflatoxin B_1 concentration of diets fed to lactating cows with or without anti-caking agent.

	CON[1]	AF[2]	AF+G[3]
	Ingredients, % Diet DM		
Forage Mix[4]	74	74	74
Grain Mix[5]	26	18	18
Ground Corn[6]	0	8	8
	Nutrients, % Diet DM		
DM, %	94.7	95.1	94.7
CP, %	16.1	18.3	16.2
NDF, %	39.9	40.2	43.8
ADF, %	20.6	22.0	23.7
Fat, %	10.1	9.52	10.3
Ash, %	7.65	8.52	8.06
Aflatoxin B_1, ppb	10.0	37.5	47.5

[1]CON = Control; [2]AF = 50 ppb aflatoxin diet; [3]AF+G = AF diet with an additional glucomannan sequestering agent. [4]Forage mix was corn silage, 60% and annual ryegrass haylage, 40%; [5]Grain mix consisted of ground corn, 40.2%; Soybean meal 48%, 27.7%; Soybean hulls, 16.1%; Wheat midds, 4.71%; Ca Carbonate, 1.96%; Fish meal, 2.35%; Blood meal, 0.78%; Megalac, 0.98%; Poultry meal 0.71%; Salt, 0.57%; Animal Fat, 0.23%; K carbonate, 0.59%; MagOx 54%, 0.47%; Potash,0.39%; Zinpro 4 Plex, 0.11%; MTB-100, 0.13%; Se, 0.02%; Mn, 0.02%; Zn, 0.02%; Co, 0.01%; Cu, 0.01%; Vit A 325, 000 IU, 0.01%; Vit D3 200,000 IU, 0.01%; Vit E, 227,000 IU; 0.014%for the CON diet. For the AF and AF+G diets, grain mix was the same, without ground corn.[6]Ground corn was added separately to the AF and AF+G diets to ensure aflatoxin contamination.

Table 2. Dry matter and nutrient intake, milk yield, feed efficiency, and aflatoxin translation in dairy cows fed aflatoxin B_1 contaminated with and without anti-caking agent[1]

Intake	CON[2]	AF[3]	AF+G[4]	SEm	*P* <		
					Trt	Week	TrtxWk
DM, lb/d	51.5	54.0	52.4	1.4	0.32	0.02	0.45
CP, lb/d	8.20[a]	8.70[a]	9.70[b]	0.30	0.01	0.03	0.34
NDF, lb/d	20.2[a]	21.1[a]	22.7[b]	0.60	0.01	0.02	0.47
ADF, lb/d	10.2[a]	11.9[b]	11.2[c]	0.40	0.01	0.02	0.35
Aflatoxin B_1, ppb/d	11.7[a]	38.4[b]	51.7[c]	0.97	0.01	0.02	0.02
Milk Yield, lb/d	60.4[a]	62.3[a]	45.4[b]	2.40	0.01	0.99	0.99
Feed Efficiency[5]	1.35[a]	1.19[a]	0.87[b]	0.09	0.01	0.01	0.01
AFM_1, ppb	0.35[x]	1.59[x]	2.35[y]	0.69	0.06	0.65	0.56
Aflatoxin M_1B_1, ppb[6]	3.48	4.26	4.94	1.66	0.75	0.72	0.43

[1]Means within rows with different superscripts are significantly different (a, b, c; P< 0.05; x, y, z; P< 0.10). [2]CON = Control; [3]AF = 50 ppb aflatoxin diet; [4]AF+G = AF diet with an additional glucomannan sequestering agent; [5]Feed Efficiency = kg milk/kg feed. [6]AFM_1:AFB_1 ratio.

is due to treatment effects as DMI was not different. No treatment effects were found for withers height, but hip height and width were greater for cows fed the AF and AF+G diets when compared to the cows fed the CON diet ($P < 0.04$).

Table 3. Body weight and measures in dairy cows fed aflatoxin B_1 contaminated diets with and without anti-caking agent[1]

Item	CON[2]	AF[3]	AF+G[4]	SEm	*P* <		
					Trt	Week	TrtxWk
Body Weight, lb	1275[a]	1453[b]	1649[c]	75.1	0.01	0.97	0.99
Withers Height, in	55.1	79.5	56.3	28.9	0.55	0.69	0.69
Hip Height, in	51.2[a]	57.9[b]	58.3[b]	2.50	0.01	0.06	0.02
Hip Width, in	18.5[a]	20.9[b]	21.7[b]	0.60	0.01	0.15	0.31

[1]Means within rows with different superscripts are significantly different (a, b, c; P< 0.05; x, y, z; P< 0.10). [2]CON = Control; [3]AF = 50 ppb aflatoxin diet; [4]AF+G = AF diet with an additional glucomannan sequestering agent.

Translation of Aflatoxin B_1 to M_1

There was a trend for increased AFM_1 as dietary AFB_1 increased (0.35 vs. 1.59 vs. 2.35 ppb, respectively; $P < 0.06$; Table 2). This disagrees with previous research indicating that the addition of a sequestering agent to the diet decreases the concentration of AFM_1 (215 vs. 113 ng/kg, respectively; $P < 0.01$; Masoero et al., 2009) and the overall proportion of aflatoxin excreted in the milk (0.038 vs. 0.021 ppb aflatoxin M_1/ ppb aflatoxin B_1, respectively; $P < 0.01$) but agrees with previous research that found MTB-100 (Alltech, Inc; Nicholasville, KY) was unable to decrease the translation of aflatoxin from the feed to the milk (Stroud, North Carolina State Univ, Raleigh, NC, MS Thesis). In that same study, the authors concluded that milk yield had no effect of aflatoxin M_1 appearance in the milk. Overall, results on the efficacy of this anti-caking agent have been conflicting, with some studies yielding positive results (Diaz et al., 2004), and others yielding the opposite (Stroud, North Carolina State Univ, Raleigh, NC, MS Thesis). Although this trial was unable to successfully reproduce positive results, it is of interest to note that the addition of MTB-100 increased the presence of the toxin in the feed and tended to increase AFM_1 concentrations. Although the results of the specific product used in this trial are unexplained, it has been previously reported that the addition of a sequestering agent to aflatoxin contaminated diet was able to increase the amount of aflatoxin excreted in the feces by not allowing absorption of the aflatoxin to occur within the rumen (Firmin et al., 2011). However, fecal data was not collected for the current trial, which provides another avenue for alternative investigative methods and future research. It is clear that further studies both *in vivo* and *in vitro* must be conducted with more thorough sampling to help generate more precise conclusions about the efficacy of this and other products regarding reducing translation of AFB_1 to AFM_1.

Implications

The particular esterified glucomannan utilized in this trial was unable to successfully or significantly reduce the transmission of aflatoxin B_1 in the feed to aflatoxin M_1 in the milk. This may be due to the fact that aflatoxin concentration in the AF+G was greater than the concentration found in the AF diet, rather than a lack of performance by the actual binding agent itself.

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Quality of Corn Silage Inoculated with *L. buchneri* and *P. pentosaceus*

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Research Summary

Corn harvested for silage, was used to evaluate the effects of inoculants on fermentation and quality. Harvested corn was 35% DM and treated with 5 x 10^5 cfu/g of *Lactobacillus buchneri* and *Pediococcus pentosaceus* (B500) or not (CON). Treatment was applied as silage was loaded into bags using a Kelly Ryan Centerline Bagger with a 9-ft tunnel; 25.28 and 27.85 tons of wet silage was loaded into the CON and B500 bag, respectively. Temperature sensors were placed in the bags and data was logged every 4 hours for 120 days. Samples were collected every 6 hours for 48 hours, every 24 hours for 5 days, then weekly for 5 weeks, and again at 90 and 120 days. Samples were analyzed for pH then subjected to proximate analysis. Samples were pooled by week (1 to 6), 90 and 120 days, analyzed for mold and mycotoxins. MIXED procedure of SAS® (Cary, NC) was used to analyze the main effects of treatment, day, and their interaction. Significance was declared at P< 0.05. Interaction of treatment and day was significant for all measures of proximate analysis and pH. Dry matter was lower in B500 compared to CON (39.1 vs. 40.2%, respectively; $P < 0.01$). Dry matter increased in CON from 40% on d 60 to 45% on day 120 and decreased in B500 from 35% on day 60 to 25% on d120. In vitro dry matter disappearance was greater in CON compared to B500 (72.7 vs. 60.9%. respectively, $P < 0.01$). On day 7, 8, and 50 CON had greater NDF (53.6, 52.3, 52.7%, respectively) and ADF (25.9, 29.3, 28.8%, respectively) than B500 (NDF: 43.5, 50.1, 46.9%, respectively; ADF: 17.1, 24.3, 27.3%; respectively; $P < 0.01$), otherwise B500 had greater NDF and ADF content. CP was lower in B500 than CON on d7, 40, and 50 (7.0 vs. 7.3%; 7.5 vs. 7.8%; 8.5 vs. 9.6%; respectively, $P < 0.01$), but greater on other days. In 24 hours, pH of CON decreased faster compared to B500 (4.5 to 3.9 vs. 3.9 to 3.8, respectively; $P < 0.01$). B500 had lower pH on d1, but the reverse was observed in subsequent days. Greater spoilage was noted in B500 as time progressed. Mold count exceeded 6 x 10^6cfu/g by day 120 in B500 compared to CON (< 50,000 cfu/g). Inoculation was more effective in nutrient preservation than CON, but 60-day data indicated increased spoilage of inoculated silage.

Introduction

Inoculants are commonly used additives in silage preparation in the U.S. Inoculants are categorized by bacteria type into two groups: homofermentative and heterofermentative. Homofermentative inoculants contain bacteria species such as *Lactobacillus plantarum*, *Enterococcus faecium,* and *Pediococcus pentosaceus*. The purpose of homofermentive inoculants is to ensure rapid fermentation with lower levels of acetic acid and ethanol and a greater concentration of lactic acid. These inoculants have decreased dry matter (DM)

loss (Muck 1996). Aerobic stability has not been improved because the lactic acid serves as a growth medium for spoilage causing yeast and molds. The heterofermentative bacteria *L.buchneri* has the ability to convert lactate to acetate. Acetate is a potent antimycotic agent that is not as metabolizable as lactate by aerobic microorganisms. Because of the increase in acetate production in the silage there is a decrease in the growth of yeast and molds, thus enhancing the aerobic stability (Ranjit and Kung Jr. 2000). Unlike most homofermentative inoculants, the heterofementative inoculants typical only enhance the aerobic stability (Driehus et al., 2001; Adesogana et al., 2003; Huisden et al., 2008). Dual purpose inoculants contain both hetero and homo fermentative inoculants, to overcome the limits of either inoculants on their own. Adesogan and Salawu, 2004, saw an improvement in fermentation in pea wheat but no improvements were observed in aerobic stability. Driehus et al., 2001 reported that when the heterofermentative inoculant *L. buchneri* is combinded with *Pediococcus pentosaceus* and *Lactobacillus plantrum,* aerobic stability is improved through reduced yeast and mold and the DM loss was decreased in grass silages. Although the inoculants take a different approach, the goal is to preserve the nutritional value of the forage for livestock consumption. Studies related to animal performance are very few, but available studies have similar results. Arriola et al., 2001 reported the application of *L. buchneri* did not affect intakes of DM, CP, ADF, or NDF, despite the high level of acetic acid found in silage. Bayatkoushar et al., 2011 did see a greater DM intake with inoculation, but did not see an increase in milk yield. Studies from 1985 to 1992 were reviewed by Muck (1993) where the authors reported the application of homofermentative inoculants increased DM intake and weight gain in 25% of the cases, in 45% of the studies milk yields and feed efficiency were also increased. The objective of this study is was to evaluate the effects of nutrient preservation and fermentation on corn silage inoculated with or without a dual-purpose inoculant.

Procedures

Corn was harvested on July 21-22, 2012 using a forage chopper with a kernel processor. At harvest, corn was 35% DM and treated with 5×10^5 cfu/g of *Lactobacillus buchneri* and *Pediococcus pentosaceus* (B500) or not (CON). Treatment was applied as silage was loaded into bags using a Kelly Ryan Centerline Bagger with a 9-ft tunnel. The CON bag had, 25.28 T and the B500 bag had 27.85 T of wet silage. Temperature sensors were placed in the bags at the center and 5 feet to the left and right of the center. Each sensor had three depths at 5, 17 and 29 inches. After introducing the sensor, punctures were sealed and a second layer of bag material was placed over each insertion point as additional weather protection. Data from the linear sensor arrays were recorded by a CR1000 (Campbell Scientific, Logan, Utah) data logger. A weather station (Hobo U30/NRC, Onset Computer, Pocasset, Mass.) was placed at the bag location to measure ambient environmental factors including temperature, solar radiation, precipitation, wind speed, and wind direction. Data from within the bag and the ambient conditions were originally recorded at a 4-hour interval for 120 days (Mader et al., 2004).

Results

Silage treated with B500 was lower in DM and ash but had greater CP, NDF, and ADF compared to CON, on average (Table 1). Silage fermentation data indicated CON silage experienced homolactic fermentation (Table 2). This is noted by the high lactic acid concentrations and the rapid decline in pH. Control silage had good fermentation throughout the trial. Silage treated with B500 underwent homolactic fermentation during the first 30 days of ensiling, then shifted to heterolactic fermentation resulting in increased acetic acid ratios. From day 60 to 90 fermentation was poor and by day 90 there were no detectable amount of acids in B500. The rapid production of acids in the CON silage would explain why yeast and mold production were lower compared to B500. Mold count exceeded 6 x 10^6 cfu/g by day 120 in B500 compared to CON (< 50,000 cfu/g). Higher counts of yeast and molds are usually an indication of increased oxygen exposure due to poor packing.

Table 1. Chemical composition of fresh corn silage and corn silage that had been treated with Buchneri 500 (B500) or not.

Item	Control	B500	SE	*P* <		
				Treatment	Day	Treatment*Day
Initial Corn Silage						
DM %	32.5	36.5				
ASH	4.33	3.96				
CP % of DM	7.74	6.97				
NDF % DM	51.7	54.8				
ADF % DM	25.4	28.6				
pH	5.7	4.2				
Corn Silage						
DM %	40.25	39.15	0.22	0.01	0.01	0.01
ASH	5.03	4.99	0.19	0.90	0.02	0.50
CP % of DM	7.78	8.45	0.04	0.01	0.01	0.01
NDF % DM	46.48	50.13	0.43	0.01	0.01	0.01
ADF % DM	22.54	26.14	0.63	0.01	0.01	0.01
IVDMD %	72.70	60.97	0.98	0.01	0.01	0.01
pH	4.06	4.29	0.04	0.01	0.01	0.01
Yeast, cfu/g	300,000	6,000,000		NA	NA	NA
Mold cfu/g	<1,000	2,000,000		NA	NA	NA

Samples were collected every 6 hours for 48 hours, every 24 hours for 5 days, then weekly for 5 weeks, and again at 90 and 120 days. Samples were collected using 63 in partitioned grain probe with 10 openings. Samples were taken at three designated spots on each bag around 1.5 feet below each temperature sensor. Upon collection of each sample a pH test was conducted prior to storage. Samples were stored in a freezer at 32°F until enough samples were collected to take to the drying oven. Samples were analyzed for pH then subjected to proximate analysis.

Samples were pooled by week (1 to 6), 90 and 120 days, analyzed for mold and mycotoxins. Sample collected in weeks 5 and 6, 90 and 120 days were analyzed for IVDM.

Table 2. Products of fermentation of corn silage with or without inoculation[1]

Item	Time (days)			
	7	30	60	90
Control				
pH	3.92	4.17	3.77	3.71
Lactic acid %DM	3.70	2.70	4.40	6.10
Acetic acid % DM	1.28	1.75	1.90	2.45
Propionic acid %DM	0.01	0.04	0.0	0.03
Butyric acid %DM	0.0	0.0	0.0	0.0
Ammonia % CP	6.39	10.07	8.03	9.81
B500				
pH	3.90	4.52	4.11	8.83
Lactic acid %DM	3.90	1.30	2.50	0.11
Acetic acid % DM	1.90	1.17	3.70	0.0
Propionic acid %DM	0.0	0.13	0.75	0.0
Butyric acid %DM	0.0	0.0	0.0	0.0
Ammonia % CP	6.50	8.89	10.09	8.29

[1]Statistical analysis was not performed because only one sample was analyzed.

Silage samples were allowed to defrost at room temperature for 6 hours prior to being placed in the drying oven. All samples were first dried for 72 hours at 60°F and were considered dry when there was less than 1g difference between weights. Samples were ground through a 2-mm screen Willy Mill and analyzed for DM and ash (950°F for 8 hours). Neutral detergent fiber and ADF were measured using the method of Van Soest et al. (1991) in Ankom 200 Fiber Analyzer. Crude protein was calculated from Kjeldahl nitrogen. Samples were sent to Cumberland Valley Analytical Services (CVAS, Hagerstown, MD) for fermentation, yeast, and mold analysis. Weeks 4 and 6, and d 90 and 120 samples were analyzed for yeast and molds. Weeks 1, 4, and 6 and 90 day samples were analyzed for fermentation. The experimental design was completely randomized with two treatments and with measures of time (week, day) used as repeated measures. The nutrient composition was analyzed by a MIXED procedure, and temperature data was analyzed by GLIMMIX procedures of SAS® (Cary, NC). The main effects of treatment, day, and their interaction were tested. The means were separated with the PDIFF procedure of SAS based on Fisher's F-protected least significant difference test. Significance was declared at $P < 0.05$.

Density was not measured, but neither bag packed as well as expected, still yet the CON out preformed B500 suggesting that inoculating silage will not overcome poor management of the silo. At day 120, CON silage had greater DM compared to

B500, which is opposite of expected. Dry matter was not different in either B500 or CON until day 60 and DM of B500 decreased greatly from 46.5% on d 60 to 25.6% on day 120 ($P < 0.001$, Figure 1). Across the entire 120 days, internal temperature of B500 silage was greater than CON (99.5 vs. 92.5°F, respectively; $P < 0.01$), however, the two bags were similar until day 30. Both bags also responded similarly to ambient temperatures, until day 30 when CON internal temperature decreased along with ambient and B500 increased (Figure 2). The increased internal temperature in B500 could be due to microbial breakdown of the silage, resulting in increased heat production. As ambient temperature decreased, increased heat production inside the bag could cause an increase in condensation and negatively impact the DM. Similarly, DMD was greater in CON compared to B500 (Figure 3).

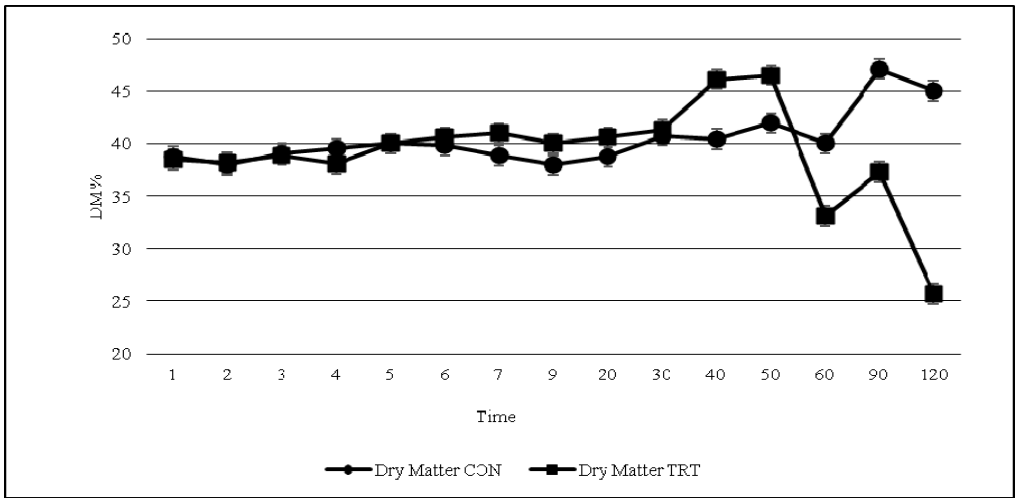

Figure 1. Effect of applying inoculant on corn silage treated with Buchneri 500 (B500) or not on DM over time in days.

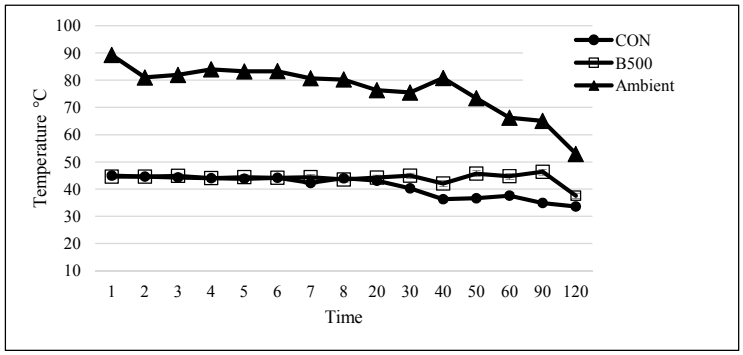

Figure 2. Effect of applying inoculant on corn silage that had been treated with Buchneri 500 (B500) or not on internal temperature and how it follows ambient temperature over time in days.

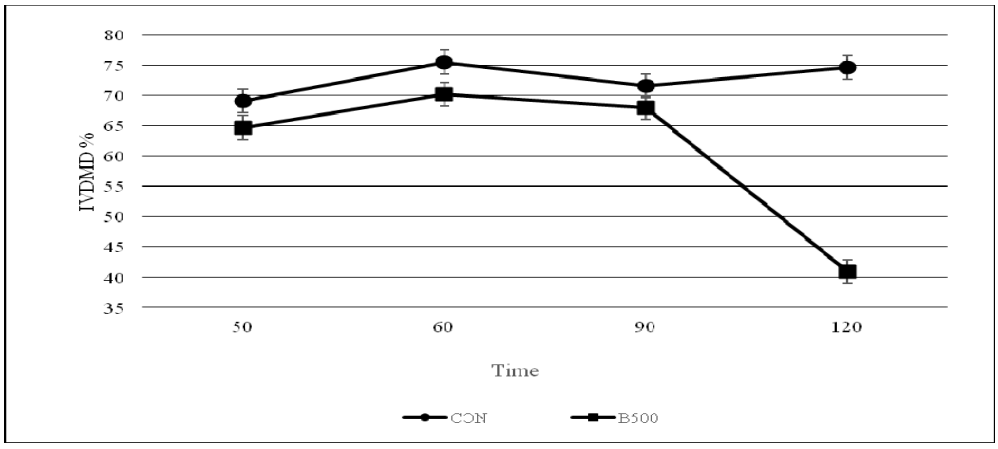

Figure 3. Effect of applying inoculant on corn silage that has been treated with Buchneri 500 (B500) or not on IVDMD over time in days.

Changes in DMD over time were similar between the two bags until day 90 when DMD decreased in B500 and increased in CON. Neutral detergent fiber was greater in B500 compared to CON on days 1, 4, 5, 20, 60, and 120 ($P < 0.001$; Figure 4). ADF values were greater in B500 silage until day 6 and were lower on days 7 and 8 compared to CON. By the end of the trial both NDF and ADF were greater in B500 compared to CON. Crude protein concentrations were not different most days (Figure 5) but on day 50, CP% was lower in B500. Control silage peaked in CP on day 50 and decreased to 7.79 by day 120 ($P < 0.001$). Control silage had a greater reduction in pH during the first 24 hours compared to the B500 (Figure 6). This was similar to results of Filya et al., 2007. From 18 to 42 hours post ensiling there was no difference in pH among treatments. At 48 hours post ensiling pH in the B500 silage increased to 4.33 ($P < 0.001$) and stayed above threshold levels until day 50. On day 60 pH of B500 silage decreased to 3.83 but then increased to 7.94 by day 120 ($P < 0.001$). Control silage stayed below threshold levels from day 20 to day 60 when pH significantly decreased to 3.68 ($P < 0.001$). Whereas, pH was below 4 on most days, on day 120 pH in CON silage reached 5.02 ($P < 0.001$).

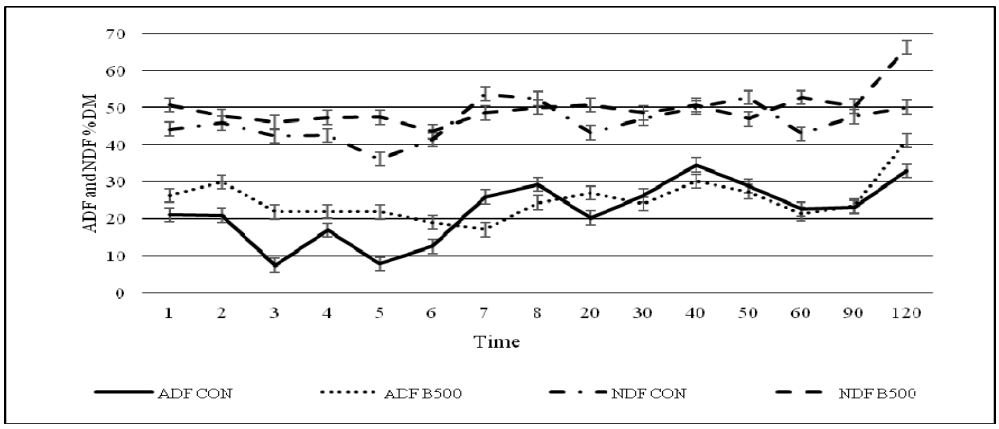

Figure 4. Effect of applying inoculant on corn silage that has been treated with Buchneri 500 (B500) or not on NDF and ADF over time in days.

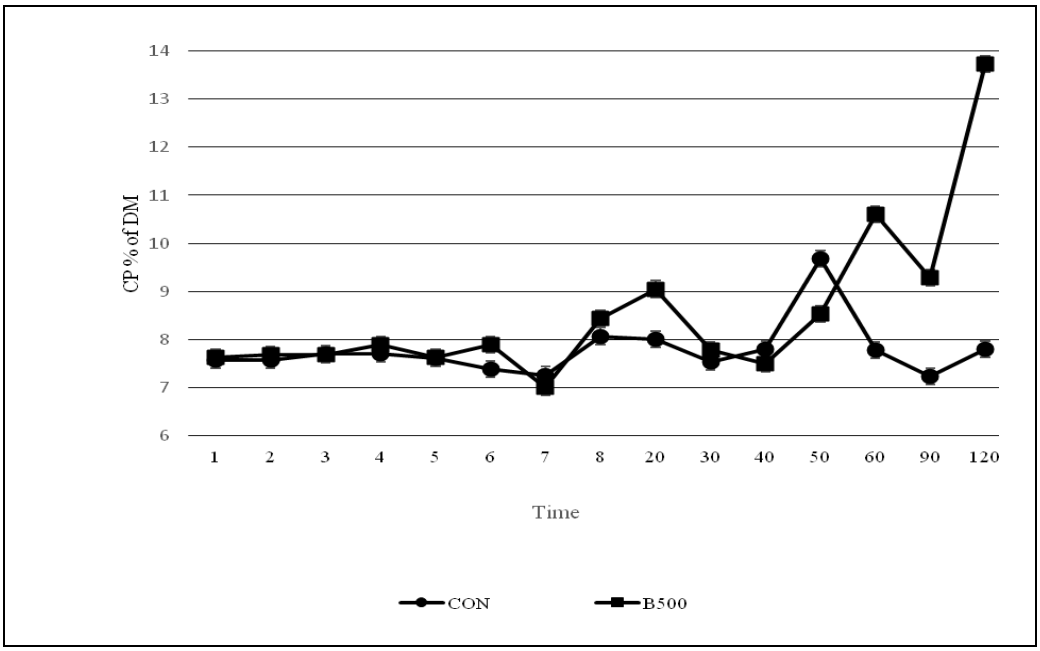

Figure 5. Effect of applying inoculant on corn silage that has been treated with Buchneri 500 (B500) or not on CP over time in days.

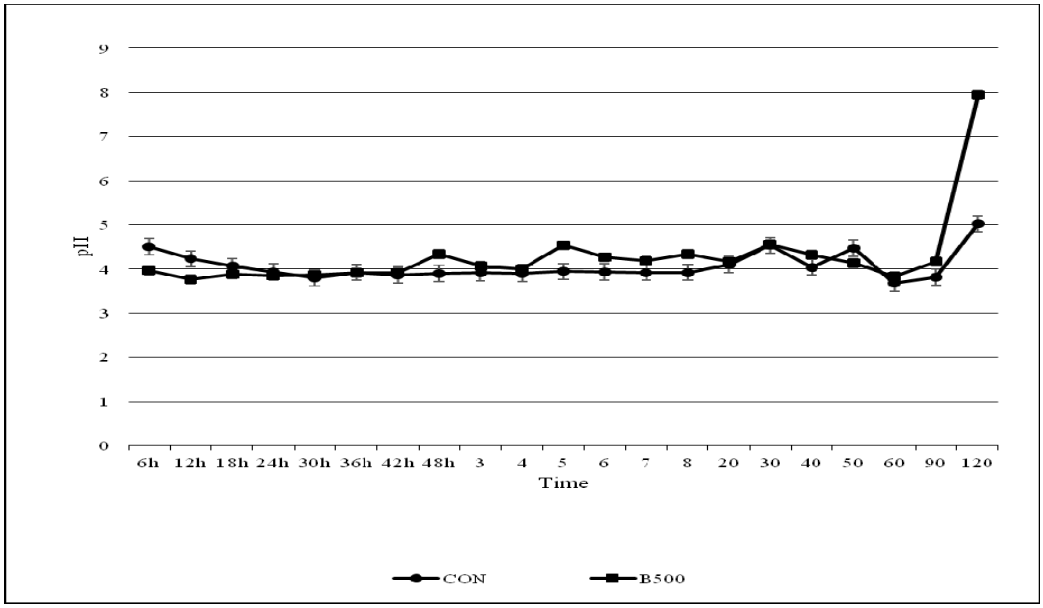

Figure 6. Effect of applying inoculant on corn silage that has been treated with Buchneri 500 (B500) or not on pH for the first 48 hour to 120 day.

Implications

The current study shows the addition of inoculant did not improve fermentation or nutrient composition past day 60 of ensiling. Inoculation with B500 had a positive effect on nutrient composition compared to CON until day 60. After day 60, post ensiling microbial inoculant had a negative effect on corn silage characteristics in term of pH and fermentation. More research needs to be conducted on combination inoculant to determine the efficiency on large scale production.

Acknowledgements

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Evaluation of a Hair Coat Scoring System for Winter Growth and Relationship to Performance in Angus Dams

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Research Summary

The objectives of this study were to (1) determine the effectiveness of a visual hair scoring system for fall and winter hair growth and length and (2) evaluate the effect of rate of winter hair growth on beef cattle performance in Angus females. Data were collected on Angus females (n = 98) every 28 d from August 2011 to February of 2012. Animals were observed by trained technicians for winter hair growth (WG) and winter hair length (WL) and were given a visual numeric rating of 1 to 5 respectively. For winter hair growth scores, a 1 = no winter growth (0% of winter coat), 2 = 25% of winter coat, 3 = 50% of winter coat, 4 = 75% of winter coat, and 5 = full winter coat (100% of winter coat). When observing winter length scores, a 1 = short, 2 = mixture of short and medium length, 3 = medium length, 4 = mixture of medium and long, and 5 = long. A 2-in x 4-in hair sample was clipped directly behind the left shoulder below the top line and weighed. Month of first winter growth (MFWG) was determined when the female reached a winter growth score of 3 or higher. Phenotypic correlations were estimated on WG, WL, and hair weight. Positive correlations were found between WG and WL (0.86), WG and hair weight (0.44) and WL and hair weight (0.64). Visual scores for WG and WL were found to be significant for hair weight ($P < 0.0001$). MFWG was not significant for weaning weight at 205 days ($P < 0.28$) and BCS ($P < 0.06$). Results indicate validity of the visual method for determining hair growth and do not suggest an association between winter growth scores and performance traits in Angus dams.

Introduction

Heat stress from the environment has a significant impact on beef cattle performance in the Southern United States. Research reports that from $441 to $502 million is lost annually from decreased reproductive traits in beef cattle due to heat stress alone (Bellows, 2002). In addition, environmental stress impacts other performance measures such as decreasing weight gain in stocker cattle (Ray, 1989). Selecting environmentally adapted cattle is one method to negate these reproductive losses and subsequently increase productivity.

Genetic selection for phenotypic traits associated with increased adaptability to elevated temperatures and humidity within the temperate *Bos taurus* breeds is one possible method to increase performance in the Southeastern cattle industry. Traits that can be related to environmental adaptation include coat color, hair coat type, and perspiration rate. Australian scientists determined that visual scoring hair for length resulted in highly correlated values between hair score and

rectal temperatures with a heritability of 0.60 for hair score (Turner, 1960). A study conducted by North Carolina State University and Mississippi State University found that Angus females which completed shedding by May weaned calves significantly heavier than females who shed after May (Gray, 2011). These findings suggest that selection for earlier shedding or a shorter hair coat can impact environmental adaptability.

Although timing of hair coat shedding and hair coat length have both been observed to impact environmental adaptability and animal performance, the impact of fall and winter hair growth on performance has not been evaluated. This research was conducted to:

1. To determine the effectiveness of a visual hair scoring system for fall and winter hair growth and length.
2. To evaluate the effect of rate of winter hair growth on beef cattle performance in Angus females.

Procedures

Experimental Protocol

Ninety eight fall calving Purebred Angus females with calf at side from the Leveck Animal Research Center were used in this study. Visual Scores were collected every 28 days for Winter Growth (WG) and Winter Length (WL) by two technicians from August 2011 to February 2012 on the dams only and were given a visual numeric rating of 1 to 5 respectively. A score of 1 for hair growth indicated no winter growth, a score of 3 indicated fifty percent of growth is present, and a 5 indicated a full winter coat. A score of 1 for hair length was rated as short (<1 in), a score of 3 indicated medium length (between 1 and 2in), and a 5 was rated as long (> 2 inches). Winter length scores were approximated. A hair sample was collected in August, October, December, and February from a 2- x 4-in area directly behind the shoulder and approximately 6 in from the topline. The sample was collected from the same location on the animal for each month to determine hair growth between collection dates. Adjusted 205-day weaning weights were calculated from the actual weaning weights of the calves by the American Angus Association.

Analytical Protocol

Month of first winter growth (MFWG) was determined when an animal reached an average WG score of three for a given month. A score of three for MFWG was selected to ensure that hair growth had occurred and could be visually determined. Hair samples were weighed using a MonoBloc digital scale (Mettler Toledo, Switzerland).

Statistical Analysis

Simple correlations were estimated using the CORR procedure in SAS® (Cary, NC). Performance and hair weight data were analyzed using the MIXED procedure in SAS® with body condition score (BCS) of the cow and adjusted 205 day weaning weight of the calves as the response variables.

Results

Positive correlations were found between WG and hair weight (0.44), WL and hair weight (0.64), and WG and WL (0.86) (Tables 1 and 1a). The positive correlations between hair weight and both WG and WL indicate that as hair scores go from 1 to 5, hair weight tends to increase.

This helps to provide some validity to the scoring methods used for both WG and WL. There was a strong positive correlation between WG and WL. As winter hair grew longer, we would expect an increase in length as well.

Table 1. Phenotypic correlations between hair score and hair weight.

Score	Hair Weight	*P*-value
WG[1]	0.44	<.0001
WL[2]	0.64	<.0001

[1]WG = Winter Growth, [2]WL = Winter Length.

Table 1a. Phenotypic correlations between winter growth and winter length.

Score	WG[1]	*P*-value
WL[2]	0.86	<.0001

[1]WG = Winter Growth, [2]WL = Winter Length.

Results for WG and WL score with hair weight are in Table 2. WG score was significant ($P < 0.0001$) for hair weight. Winter growth scores of 3 and 4 were similar and had heaviest hair weights of all WG scores. A WG score of 2 was the intermediate between a 3 and 4 and a 1 or 5 which were similar. Although not all scores were statistically different, hair weight increased as WG score increased from scores 1 through 4. An important consideration is that no statistical difference was present between a score of 1 and 5. As a score of 5 would indicate completed growth, we would expect this sample to have the greatest weight. An analysis of the collection method could explain this discrepancy. At each collection, a hair sample was taken at the same location on each animal. This is important because the samples were not total accumulated hair growth from August to February, but growth from one collection date to the next. It was our observation that at the end of the winter season, hair growth had slowed or stopped. This led us to score all animals in February as a WG score of 5 to indicate that the winter hair coat was complete. The hair weights collected in February was an accumulation of hair growth from January to February and was similar to weights collected in August when most scores were a 1. A score of 1 would denote a short summer coat or that winter growth had not started. This could explain why a score of a 1 and 5 for WG were similar in hair weights.

Winter Length (WL) was also significant for hair weight ($P < 0.0001$). A WL score of 5 was heaviest indicating more hair mass when compared to all other scores. A score of 2 and 3 were similar for hair weights with a score of 1 being the lightest. Results were as expected with increasing hair weight as visual numeric score increased except for a score of 2 and 3 which were not significantly different from one another. This lack of statistical difference can be attributed to the difficulty of determining the difference between length scores that are close together in

contrast to the extremes. Although not all WG and WL scores were statistically different, results support the use of these scales as a method for appraising hair growth and length.

Table 2. Least Square Means for hair weight in ounces.

Visual Score	WG[1]	WL[2]
1	0.012 ± 0.0007[a]	0.010 ± 0.0007[a]
2	0.017 ± 0.0014[b]	0.013± 0.0007[b]
3	0.020 ± 0.0007[c]	0.014 ± 0.0004[b]
4	0.020 ± 0.0007[c]	0.016 ± 0.0007[c]
5	0.012 ± 0.0004[a]	0.026 ± 0.0014[d]

[a,b,c,d] LS Means with different superscript within column differ $P < 0.05$.
[1]WG = Winter Growth, [2]WL = Winter Length.

Because of the difficulty in visually seeing the start of winter growth, it was determined that MFWG was when an animal reached a WG score of 3 to be certain that growth had initiated. Month of First Winter Growth (MFWG) was not significant for adjusted 205-day weaning weight ($P < 0.28$) of the calf or BCS for the cow.

Results are in Table 3. Adjusted 205-day weaning wt was not significant but did show a trend for increasing weaning weights as growth occurred later through the winter. Body condition score approached significance ($P < 0.06$). Body condition score means were all scores of six which in reality would be no difference in body condition. All cattle scored were a BCS of 5 to 8 throughout the study with no cows being in inadequate condition.

Table 3. Least Square Means for BCS and 205-day Weaning Weight in lbs.

MFWG[1]	BCS[2]	205 day Weaning Weight[3]
November	6.65 ± 0.13[a]	518 ± 23.4[a]
December	6.39 ± 0.07[a]	546 ± 14.3[a]
January	6.52 ± 0.13[a]	558 ± 22.9[a]

[a,b,c,d] LS Means with different superscript within column differ $P < 0.05$.
[1]MFWG = Month of first winter growth, [2]BCS = Body condition score, [3]205-day Weaning Weight = 205-day adjusted weaning weight

Implications

In this study, the visual method of scoring winter growth and length used was shown to be associated with hair weight and could possibly be used in determining winter hair growth. Additional data will be collected in this area to fully explore the relationship, if any, to cow performance.

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Evaluation of Eye and Eyelid Pigmentation in White-Faced Cattle

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Research Summary

Digital images of eyes of Hereford straightbred and crossbred calves in 11 research herds across the Southern United States were acquired. The proportion of each eyelid that was pigmented (non-white) was assessed with subjective scores as well as the presence of corneoscleral pigmentation (pigment occurring on the white of the eye). Both of these characters may exert preventive influence on the occurrence of precancerous eye lesions. Straightbred Herefords had lower eyelid pigmentation scores (indicating lower proportion of pigmented areas on eyelids) than white face *Bos taurus* or Brahman crosses or Brahman-influenced cattle. Straight Hereford had lower occurrence of corneoscleral pigmentation than both other breed groups; Brahman-influenced or crossbreds had lower occurrence than *Bos taurus* crossbreds. This work is a preliminary characterization of these traits for subsequent genomic association study.

Introduction

Hereford cattle are widely used in a variety of production schemes and the breed has the reputation for high levels of heterosis in combination with many other breeds. However, production losses in cattle with Hereford background due to bovine ocular squamous cell carcinoma (commonly called “cancer eye”) are serious in the U.S. beef industry. The concern is from condemned carcasses at slaughter and shortened productive life of affected animals. Anderson et al. (1957) and Anderson (1960, 1963, 1991) reported the lower incidence of bovine ocular squamous cell carcinoma in white faced cattle with increased pigmentation around the eyes. Areas of corneoscleral pigmentation may form as a response to the occurrence of pre-cancerous lesions. Updated characterization of eye pigmentation in Hereford straightbreds and crossbreds would facilitate identification of responsible genomic regions. The objectives of this study were to 1) assess variation in eyelid pigmentation , Hereford **×** *Bos taurus* and Hereford **×** *Bos indicus* cross animals 3) assess variation in corneoscleral pigmentation in these animals.

Procedures

Cattle at multiple locations across the Southern United States contributed records to this project (Table 1). Digital images were taken of both eyes on mature animals and calves that had white faces at those locations in 2012 (Figure 1). Using those images, values were assigned as subjective quantification (proportion

pigmented) of eyelid pigmentation: 1 = no pigmentation; 2 = 0.01 to 0.39; 3 = 0.4 to 0.6; 4 = 0.61 to 0.99; 5 = complete pigmentation. Values of 1 and 0 were assigned to images indicating the presence or absence, respectively, of corneoscleral pigmentation. Analyses were completed using ASReml (Gilmour et al., 2009). Fixed effects investigated included location, animal age (2 levels: mature animal and calf), and breed type of animal (Hereford, *Bos taurus* cross, *Bos indicus* cross [including Braford]). Animal was a random effect. Corneoscleral pigmentation was modeled as binomially-distributed, and a logit link function was applied to these data. Eyelid pigmentation scores were grouped and analyzed by eye (right and left).

Figure 1. Examples of images: Top--Full representation of pigment; Middle--Varying corneoscleral and eyelid pigmentation; Bottom-- Incomplete eyelid pigmentation

Results

There was no detected difference between mature animals and calves for either trait ($P > 0.2$). Anderson (1991) noted the increased occurrence of corneoscleral pigmentation with increasing age in mature animals. Eyelid pigmentation score was lower ($P < 0.05$) for Hereford animals than for *Bos taurus* or *Bos indicus*

crosses in both right and left eyes (Table 2), indicating lower amounts of eyelid pigmentation. All breed group means for the occurrence of corneoscleral pigmentation differed ($P < 0.05$); *Bos taurus* crosses had the largest frequency and Hereford had the lowest frequency.

Table 1. Numbers of animals with records by breed group and location

Location	Hereford	*Bos taurus*	*Bos indicus*	Total
Texas AgriLife				
College Station	4	74	5	83
McGregor	1	2	82	85
Clemson University	68	108		176
Oklahoma State University		102		102
Mississippi State University				
Starkville	29	38		67
Raymond	1	4	17	22
University of Florida				
Ona			90	90
Marianna			52	52
Louisiana State University			104	104
University of Arkansas		34		34
North Carolina State University		54		54
Total	103	416	350	869

Table 2. Pigmentation means for breed type (right eye, left eye)

	Eyelid		Corneoscleral
	Right	Left	
Hereford	3.46[b]	3.47[b]	0.34[c]
Bos taurus crosses	4.57[a]	4.54[a]	0.81[a]
Bos indicus crosses	4.67[a]	4.64[a]	0.64[b]
Average SE	0.63	0.66	0.03

[a,b,c]Means in the same column that do not share a superscript differ ($P < 0.05$).

Implications

These data and analyses are preliminary and subordinate to the ultimate goal of this work: to identify gene(s) responsible for these pigmentation traits. It would be of great benefit, for example to genomically identify bulls that would produce white faced progeny that would consistently have pigmented eyelids. Not enough is understood of corneoscleral pigmentation—its responsive role to lesion formation on the eyeball has not been extensively characterized.

The target is 2000 animals with records in this project—existing data will be augmented with calves born each year and inclusion of data from more collaborators, including private herds. There are several subsequent steps. We are currently investigating methodology to digitally

quantify pigmentation, rather than assign subjective scores. Acquisition of chip-based high density SNP genotypes (e.g., Bovine SNP50 or Bovine HD; Illumina, Inc. San Diego, CA) to use with image values will be a critical part of associating differences in pigmentation with areas in the bovine genome. We will get annual images for mature animals that remain in these herds in attempt to confirm changing corneoscleral pigmentation.

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Effects of Three Shade Types on Alleviation of Heat Stress in Grazing Dairy Heifers

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Research Summary

Twenty-one yearling, Holstein heifers (n=7), were assigned to one of three paddocks, each with a different type of shade: 1) Natural shade from trees (**T**); 2) Hutches (**H**); 3) Shade cloth (**SC**). All heifers were fed a commercial grain mix, ryegrass hay, and grazed a grass-legume mix pasture. Body weight and frame measures, rectal temperatures, and blood samples were collected once per week. Heifer behavior was observed twice weekly for a total of 24 hours. There was a tendency for decreased body weights in heifers housed under SC, but ADG, wither height, or hip height were not affected by shade type. Blood parameters were not affected by shade type. Time spent in the shade versus not was also not different with shade type, but time spent lying down was greater in both T and SC when compared to H ($P < 0.05$). Temperature was also lower in T and SC compared to H, which may have contributed to decreased time lying down.

Introduction

Heat stress is a condition that all livestock producers struggle to control, especially in the Southeastern United States. Heat stress is induced by high temperatures and high humidity and causes physiological changes in the animals it affects. Production animals that suffer from heat stress will generally experience high respiratory rates, decreased weight gain and feed efficiency, and reproductive failure. These effects ultimately lead to economic losses for the producer. In addition to growing concerns about animal welfare, this topic has been the subject of many scientific studies to find an efficient and effective way to mitigate heat stress to decrease production losses. The addition of electrolytes to the diet (West, 1997) and the implementation of natural and man-made shade are the two most common themes for such studies.

For years it has been common practice to use shade to mitigate the effects heat stress. Data exist describing the benefits of shade as a management practice. Silanikove (2000) describes how implementation of shade, water, breed type, and limited transportation contribute to the reduction of heat stress in production animals and animal welfare. Additionally, shade leads to reduced respiration rate and rectal temperature (West, 2003). Brown-Brandl, et al., (2005) used 8 crossbred steers, randomly assigned to 8 pens (4 with shade, 4 with no shade) to investigate the impact of shade on physiological response in beef cattle in a feedlot. After 37 days, shade decreased the respiration rate and core body temperature of the steers during the peak temperatures of the day. Moreover, Mitlöhner et al. (2001) measured the effects that shading versus misting had on mitigating heat stress. The authors concluded that shade decreased heat stress and the negative

effects of heat on performance while misting was largely ineffective. Finally, Mitlöhner et al. (2002) a study was examined the effects shade had on performance, behavior, physiology, and carcass traits of beef heifers in a heat stressed environment for 121 days. Mitlöhner et al. (2002) determined that after the 121 days the shaded heifers had increased DMI, ADG, and final BW; additionally, more of the shaded heifer carcasses graded USDA Choice. The objective of this study was to compare physiological and behavioral responses in Holstein heifers housed under a shade cloth or hutch when compared to natural (trees) shade.

Procedures

Twenty-one yearling, Holstein heifers (n=7, per treatment; include BW as well), were assigned to one of three paddocks, each with a different type of shade: 1) Natural shade from trees (**T**); 2) Hutches (**H**); 3) Shade cloth (**SC**). Each pen was fed 23 kg grain/day of a commercial heifer mix (Purina Heifer Feed). Heifers also grazed a mixed grass and legume pasture (70% Bermudagrass; 30% clover) and were given one bale (550 kg) of annual ryegrass hay every 3 days. Heifers also had unrestricted access to water in each paddock, though water intake was not measured. Body weights and measures (hip height and wither height) were measured weekly along with rectal temperature. A blood sample was also taken once weekly via jugular venipuncture and was analyzed for hematocrit and total protein after centrifugation using a BRIX refractometer. Feed samples were taken once weekly, because heifers were not fed for weighbacks, orts samples were not collected. Individual dry matter intake was not measured. Feed samples were subjected to proximate analysis and analyzed for Kjeldhal nitrogen. Twice per week, heifers were observed for 12 hours and position (lying, standing, drinking, grazing) and location (shade or no shade) was recorded every 30 minutes. In addition, ambient temperature both in and out of the shade was recorded.

Data Collection and Statistical Analysis

Total heifer shade hours were calculated by multiplying the number of heifers in shade by the number of hours spent in shade, according to Brown-Brandl et al., (2005). Data were compiled and analyzed using the GLM and MIXED procedures of SAS. The model included main effects of week, time and shade type and all interactions were tested. Significance was declared at $P < 0.05$.

Results

Heifer grain mix was 89% DM, 19% CP, 36% NDF, and 13% ADF. The ryegrass hay was 70% DM, 13.9% CP, 57.7% NDF, and 36.9% ADF. Pasture was not sampled. Body weight increased weekly ($P < 0.01$, Table 1) and there was a tendency for decreased body weight in heifers housed under SC ($P < 0.08$). Shade type did not impact ADG, WH, or HH (Table 1). Hematocrit, serum total protein, and rectal temperature were also unaffected by shade type ($P > 0.05$; Table 2).

Table 1. Growth measurements in Holstein heifers subjected to three different shade types

Item	Trees	Hutch	Cloth	SEm	*P* <[1]		
					SH	WK	SH x WK
BW, kg	534.5^{x,y}	546.0^{x}	512.7^{y}	10.4	0.08	0.01	0.01
ADG, kg/d	1.62	1.36	1.21	0.15	0.22	0.22	0.22
WH, cm	45.2	45.3	44.2	0.57	0.31	0.01	0.73
HH, cm	48.5	48.1	47.3	0.55	0.27	0.01	0.65

[1]SH= Shade type, WK = week, SHxWK= interaction of shade type and week. Means with different superscripts (a, b, c) are different at P < 0.05. Means with different superscripts (x, y, z) are different at *P* < 0.01.

Table 2. Blood parameters in Holstein heifers subjected to three different shade types

Item	Trees	Hutch	Cloth	SEm	*P* <[1]		
					SH	WK	SH*WK
Hematocrit, %	33.6	32.8	33.5	0.7	0.74	0.09	0.36
Total Protein, mg/dL	7.13	7.35	7.11	0.12	0.22	0.09	0.27
Rectal Temp, °C	101.8	101.8	101.8	0.06	0.89	0.01	0.01

[1]SH= Shade type, WK = week, SHxWK= interaction of shade type and week. Means with different superscripts (a, b, c) are different at *P* < 0.05. Means with different superscripts (x, y, z) are different at *P* < 0.01.

Temperature under the shade structures was lower in T and SC compared to H (Table 3). This is likely because the hutches (MultiMax Hutch, Hampel Corp, Germantown, WI), though built for multiple animals, have very little ventilation. Macaulay et al., (1995) reported similar results in pre-weaned calves, where dome hutches had increased air temperature as compared to wooden and polymer hutches. Spain and Spiers (1996) reported that calves housed in hutches with supplemental shade had lower skin temperatures and respiration rates compared to those without supplemental shade. Time spent lying down was greater in both T and SC when compared to H indicating again, that during increased ambient temperatures the hutch is not a comfortable option for heifers. These results are similar to those of Mitlöhner, et al., (2002) who reported that heifers housed under shade in a feedlot spent more time laying down compared to those not under shade. The latter group also reported an increase in DMI and ADG when animals were shaded, which we did not find.

Table 3. Shade temperature and time spent lying, drinking, or grazing in Holstein heifers subjected to three different shade types.

Item	Trees	Hutch	Cloth	SEm	*P* <[1]		
					SH	Time	SHxTime
Shade Temp, °C	84.0[a]	86.7[b]	84.9[a]	0.51	0.01	0.01	1.00
Shade time, hfh[2]	2.12	2.07	2.15	0.10	0.89	0.01	0.89
Non-shade time, hfh	1.37	1.42	1.34	0.10	0.87	0.01	0.88
Lying Time, hfh	1.38 [a]	0.96 [b]	1.14 [b]	0.09	0.004	0.01	0.34
Drinking Time, hfh	0.13	0.23	0.20	0.04	0.25	0.01	0.99
Grazing Time, hfh	1.48	1.79	1.69	0.10	0.13	0.01	0.77

[1]SH= Shade type, Time = time of day, SHxTime= interaction of shade type and time of day. Means with different superscripts (a, b, c) are different at P < 0.05. Means with different superscripts (x, y, z) are different at *P* < 0.01.
[2]Hfh= Heifer hours. Total heifer hours were calculated by multiplying the number of heifers in shade by the number of hours spent in shade, according to Brown-Brandl et al., (2005).

The difference in temperature, however, did not seem to impact time spent in the shade as the number of heifer hours spent in the shade was not different within the three types. During the hottest part of the day (1:00 p.m. to 6:00 p.m.), heifers maximized their time in the shade (Figure 1). When compared to H and SC, heifers housed under trees sought out shade later in the morning hours and remained in the shade until later in the evening hours. Although in this paddock the majority of the shade provided by trees was along a fence line, it is possible that the trees protected the paddock from solar radiation for a longer period of time.

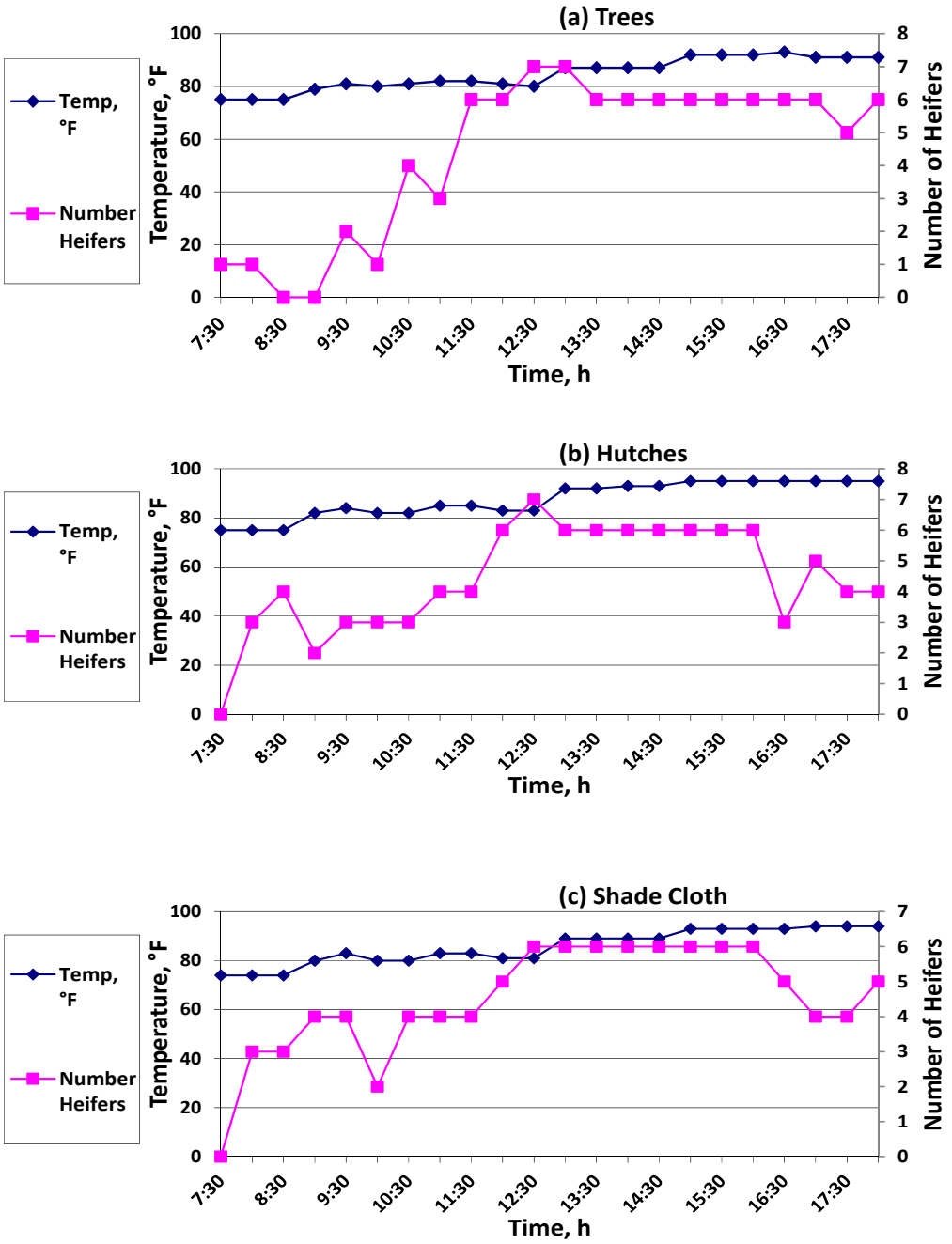

Figure 1. Temperature and number of Holstein heifers in shade with (a) trees, (b) hutches, or (c) shade cloth.

Implications

Data from this study indicate less of a preference for shade type between shade cloth and trees (or natural shade), but even during hot temperatures, heifers did not seek shade inside polypropylene hutches. Air temperatures were increased in hutches and that is likely due to lack of adequate ventilation, which also deterred the heifers. When designing pasture based housing for

heifers, it is important to consider shade options and adequate tree coverage (most often along fence lines) could provide sufficient cooling for heifers in summer months.

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2013 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 1,331 market animals exhibited at 1 of 5 District Livestock Shows, 42 market animals qualified for the 44th Sale of Champions auction in 2013. These animals sold for $316,913.75, with 80% of the money going to the exhibitor and 20% into a scholarship fund and to pay expenses of the sale. In addition, 34 youth were recognized for their academic accomplishments and successes with breeding animals, and $53,500 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 2012 and early 2013 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 41 to 44 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, three-hundred thirty-one 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, 1,143 animals were exhibited at the Junior Round-Up from which 42 market animals qualified for the Sale of Junior Champions. The sale included 8 market steers, 13 market hogs, 12 market lambs and 9 market goats. These 42 animals sold for a record total of $316,913.75, making it the 19th consecutive year the sale grossed over $100,000. To date, the 44 combined sales have grossed a very impressive $5.1 million dollars.

Although 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). Forty-five applications were received for the Academic Scholarships in 2013. In addition, the Premier Exhibitor contest recognized the winner of each of the 5 species shown (beef, 43 entries; dairy, 6 entries; sheep, 2 entries; swine, 13 entries; and goat, 20 entries) with $2,000 scholarships, totaling $10,000. Finally, the exhibitor of the Supreme Beef Bull, Supreme Beef Female, Supreme Dairy Cattle Female and Supreme Dairy Goat Female received a $1,500 Supreme Animal Scholarship, totaling $6,000. Altogether, $53,500 in scholarships was awarded to 34 youth by the Sale of Champions Promotion Committee. The scholarship program was initiated in 1993, and to date, 467 scholarships have been awarded for a total of $551,200.

Implications

Committee members worked diligently in preparing for the 2013 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.

2013 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, 2,248 animals were exhibited by 1,525 youth, making this the fourth largest Dixie National Junior Round-Up livestock show in the past decade. 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 education 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. If one of their market animals was Mississippi bred, youth were allowed to weigh-in and show 3 market animals. 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 twenty-five 4-H and FFA youth exhibited 2,248 animals at the 2013 Dixie National Junior Round-Up, which was the fourth largest show held as compared to the past decade. The following is a breakdown of the number of entries in 2013 along with the change in number of animals shown from 2012 to 2013 shows in parenthesis: 791 beef cattle (-6); 160 dairy cattle (+13); 682 market hogs (-28); 161 market lambs (-32); 186 market goats (-12); 187 commercial meat goat does (-3); and 81 dairy goats (+14). 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 2013 Dixie National Junior Round-Up had good participation. At the Premier Exhibitor contests, there were 43 participants in the beef division, 6 in the dairy division, 2 in the lamb division, 13 in the swine division and 20 in the goat division, totaling 84 youth who participated in these contests. The winner of each Premier Exhibitor contest received a $2,000 scholarship from the Sale of Junior Champion Promotion Committee. In addition, the committee awarded 25 Academic Scholarships from the 45 applications it received with each scholarship valued at $1,500 each. Finally, the Sale of Junior Champion Promotion Committee awarded 4 $1,500 scholarships to the exhibitors of supreme animals at the Junior Round-Up. 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. Several of the species had increased numbers shown compared to 2012. 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 enjoy the challenges associated with showing livestock and competing for scholarship monies.

2013 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 yr) 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 products, 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 is 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 yr, 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 17 participants (3 in Sheep/Swine/Meat Goat; 6 in Beef; 4 in Dairy Foods; and 4 in Dairy Animals). In Meats Judging, there were 4 teams and 15 youth that competed in the contest. Dairy Products Judging had 9 teams and 36 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 33 youth submitted posters in the Dairy Poster Contest using the theme “Dairy Packs Power”. In this contest, there were 10 participants in the 8 to 10-year old division, 11 participants in the 11- to 13-year old division and 12 participants in the 14- to 18-year old division. Altogether, 118 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.

2013 4-H/FFA Replacement Beef Heifer 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 10-mo event where the contestant is personally responsible for the daily management of their heifers. During the contest, 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 fifth year of competition, 15 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 10-mo project that started on November 1, 2012, and will conclude August 9 to 10, 2013. Contestants must be 4-H or FFA members who compete as individuals unless 2 or more brothers or sisters (each at least 14 yr of age but not over 18 yr 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, 2012, 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 2012 or the spring of 2013. 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. 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, 2013. 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 fifth year of this contest, 15 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, laptop, truck/trailer hitches, cash prizes, and complementary artificial insemination school registrations for all participants, courtesy of the Mississippi State University Extension Service. 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 2014 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.

2013 Mississippi 4-H Horse Championship

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Extension Summary

The highlight of the yr for youth interested in the 4-H Horse Program is the Mississippi 4-H Horse Championship. 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 2013, 605 youth competed at district shows on 1,052 horses, with a total of 2,230 total entries participating in these shows. Overall, 66 counties had youth represented at the district shows. At the state horse show, 407 youth (representing 62 counties) competed on 641 horses, with a total of 1,169 entries being shown. The district and state shows offered numerous opportunities for junior and senior youth to compete in education contests. Altogether, 341 youth competed in these education contests. In our creative contests, Horse Art, Horse Photography and County T-shirt Design, there were over 220 youth entered and 10 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. Two new classes were offered at the state show (Ranch Riding and Ranch Trail), as these classes are now offered at the Southern Regional 4-H Horse Championship and offer an opportunity to

reach another group of youth interested in the horse project.

At the district horse shows (Northeast: Starkville, MS; Northwest: Tunica, 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 Stall Decoration/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 Championship. 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 2013, 605 youth rode 1,052 horses with a total of 2,230 entries. Overall, 66 counties had youth represented at the 4 district shows. At the state horse show, 407 youth (representing 62 counties) competed on 641 horses, with a total of 1,169 entries being shown. At the state show, participation in Ranch Riding and Ranch Trail was much better than anticipated, with 81 total riders in these two classes alone. Altogether, 341 youth competed in these educational contests at the district and state horse shows. In our creative contests, 114 youth had exhibits in Horse Art, 106 youth had exhibits in Horse Photography, 10 counties entered the County T-shirt Design Contest and 6 counties entered the County Stall Decoration/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.

Mississippi Master Cattle Producer Self-Study Program

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Extension Summary

The Mississippi Master Cattle Producer Program began in 2006 as a comprehensive training offered by the Mississippi State University Extension Service in major beef cattle production topic areas. The 8-session interactive course is designed for persons interested in learning more about improving beef cattle production and marketing practices. Training focuses on improving overall management and decision-making skills and developing a broad beef cattle production knowledge base. The Master Cattle Producer Program was first updated in 2009 with new course materials and an online format to meet the needs of persons wanting to complete the training at their own pace and schedule. Each online module consists of an Adobe Acrobat file with approximately 75 to 80 slides with associated scripts. The examination for each training topic is an interactive form containing 15 multiple-choice questions derived from the training materials. A real-time webinar version of the training was offered in 2010. Course materials were again updated in 2013, and future updates are planned as needed. Most self-study program participants have elected to pursue the free online-only version of the program. Program participation continues to grow, with participants widely dispersed across the nation and throughout the world.

Introduction

Master Cattleman-type educational programs are offered by state Extension Services to beef cattle producers in numerous U.S. states. These highly visible programs typically consist of a series of instructional sessions on a variety of general beef production topics. Many of the Master Cattleman programs certify participants as “Master Cattlemen”, upon completion of a particular curriculum and set of basic requirements.

The Mississippi Master Cattle Producer Program is a comprehensive training offered by the Mississippi State University Extension Service in major beef cattle production subject areas. The 8-session interactive course is designed for persons interested in learning more about improving beef cattle production and marketing practices. This training approach complements in-depth subject matter training programs such as short courses. Training focuses on improving overall management and decision-making skills and developing a broad beef cattle production knowledge base.

Procedures

The Mississippi Master Cattle Producer Program was first launched in Mississippi in January 2006 as a collaborative effort with the Auburn Cooperative Extension System taught over the Extension interactive video system. At

that time, the training program consisted of eight 3-hour sessions on the following topics: 1) beef cattle nutrition, 2) forage systems, 3) reproductive management, 4) selection for optimum genetics, 5) management and marketing, 6) herd health and handling practices, 7) the product: Yield and Quality Grades, and 8) Beef Quality Assurance (BQA). From course initiation in 2006 through 2008, course participants were required to complete at least 6 of the 8 sessions and become BQA certified to graduate as a Mississippi Master Cattle Producer.

This training opportunity was offered at 10 distance education sites in each state, including Attala, Clarke, Forrest, George, Hinds, Lafayette, Lee, Oktibbeha, Pike, and Winston counties in Mississippi. Nearly 400 beef cattle producers in Mississippi and Alabama completed the comprehensive Master Cattle Producer Training Program via interactive video from January to March 2006. This initial training was videotaped and made available as a self-study course on digital video disc as a 4-disc set with printed course handouts after March 2006. The self-study course was designed for persons interested in learning more about Mississippi beef cattle production at their own pace.

The Master Cattle Producer Program was updated in 2009 with a new format, course materials, and topic areas. Training currently consists of 8 modules in beef cattle production subject areas. However, producers must now successfully review all course materials and complete the exams for all 8 training topics to be eligible for Master Cattle Producer certification. Beef cattle producers enrolled in the Master Cattle Producer program complete approximately 24 hours of training which now includes the following: 1) beef cattle nutrition, 2) forage systems, 3) beef cattle reproduction, 4) breeding and genetics, 5) economics and marketing, 6) herd health and handling, 7) beef end product, and 8) BQA.

The Mississippi Master Cattle Producer Program Internet-based training modules, first made available in 2009, are online at *msucares.com/livestock/beef/mcp*. Popular press, newsletter, and radio advertisements announcing program availability and details were launched in Autumn 2009 to promote the program. A brochure was developed in 2010 to help further market the program.

Course participants can view online training modules and download training materials free of charge. Alternately, participants completing the program can receive printed course materials, a metal farm sign, Master Cattle Producer cap, and certificate of completion for a course fee of $75. The online version of the Mississippi Master Cattle Producer Program is also made available to Mississippi State University Extension Service agents for up to 24 hours of in-service training credit.

Each online module consists of an Adobe Acrobat file with approximately 75 to 80 slides with associated scripts. The training materials cite current Mississippi State University Extension Service publications as supporting references and contain information on how to access those publications on the Internet at *msucares.com/livestock/beef/beefpubs.html*. These reference materials contain detailed information beyond what is covered in the Master Cattle Producer

training slides. Contact information for the Extension Beef Cattle Specialists is also included in the training materials to encourage course participants to seek answers to any questions they may have when reviewing training materials.

The examination for each training topic is an interactive Adobe Acrobat form containing 15 multiple-choice questions derived from the training materials. The examinations can be e-mailed directly to the Extension Beef Cattle Specialist administering the program by clicking the "E-mail form" button on the form. These forms can also be saved and then e-mailed or printed and then faxed or mailed to the program administrator. Participants must answer a minimum of 12 out of 15 (80 percent) questions correctly to successfully complete a particular examination and receive credit for the associated training module. Examinations may be taken multiple times if needed to pass them.

The BQA training module is additionally offered as a video-based training via MediaSite. The BQA video training consists of 5 MediaSite presentations including: Mississippi BQA Program introduction, targeted breeding, responsible culling, proper management, and Mississippi BQA Program conclusions. These video presentations include a speaker addressing Mississippi BQA Program topics utilizing the BQA program display booths. A Microsoft PowerPoint slide show runs simultaneously on the computer screen and corresponds to the video presentation.

A live Internet-based Master Cattle Producer training was conducted in January 2010. A real-time chat feature between presenters and program participants was used during these sessions. In 2013, the course materials were updated to reflect new information. As of 2013, participants were also provided with links and/or copies of new publications referenced in the updated materials for further reading on specific topics covered in the training.

Results

Though the majority of past and present participants in the Mississippi Master Cattle Producer Program are Mississippi beef cattle producers, Mississippians from other segments of the beef cattle industry, such as feed retailers, as well as out-of-state beef cattle producers participate in the program. In addition, program participants have included persons residing in 17 different states and 5 foreign countries. Course participation has increased over time.

The online version of the program already has had greater than 100 participants actively enrolled, with many of these participants already successfully graduating from the program. Approximately two-thirds of self-study participants have completed the course in the free online-only format, whereas, the remaining one-third of these participants have elected to do the paid hard-copy version of the program.

Implications

The Mississippi Master Cattle Producer Program provides interested participants with a comprehensive training opportunity in 8 major beef cattle production topic areas. The program is offered via the Internet as a self-study

training to meet the needs of persons wanting to complete the training at their own pace and schedule. Program materials will continue to be updated as needed to provide current and relevant educational information.

MSUcares Beef Cattle Website Traffic Evaluation, 2007 to 2012

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Extension Summary

The Mississippi State University Extension Service and Mississippi Agricultural and Forestry Experiment Station joint website MSUcares, *msucares.com*, includes a beef cattle website, *msucares.com/livestock/beef*. This commodity-specific website addresses the educational needs of the Mississippi beef cattle industry and has undergone notable expansions and redesigns in recent years. Website usage statistics indicate that the average time spent on web pages within the beef cattle website has generally increased since 2007. The website represented about 1% of the total MSUcares website page views and consistently outperformed MSUcares for indicators of website visit quality including time spent on pages and bounce rate. Rankings of individual web pages within the beef cattle website provide insight into user interest in the various content and programming areas. The MSUcares beef cattle website is constantly adapting to meet industry educational needs with at least weekly updates and routine website expansions as new educational programs or resources materials are developed.

Introduction

The Mississippi State University Extension Service and Mississippi Agricultural and Forestry Experiment Station (MAFES) share a common web address. The Internet home page for both organizations is, MSUcares, *msucares.com*. The acronym 'cares' in this joint website address stands for 'Coordinated Access to the Research and Extension System'.

Links to commodity-specific Extension and research websites are located the main MSUcares homepage. Among these commodity-specific websites is the MSUcares beef cattle website, *msucares.com/livestock/beef*, which has undergone notable updates in recent years. Other livestock-related MSUcares websites include youth livestock, small ruminant, equine, dairy cattle, and swine websites.

Procedures

The MSUcares beef cattle website, addresses the educational needs of the Mississippi beef cattle industry. It currently consists of 30 web pages including a home page, calendar of events, and contact information page. Other web pages within the MSUcares beef cattle website are dedicated to the following topics: Extension publications, Cattle Business in Mississippi articles, Cattle Market Notes, Mississippi Master Cattle Producer program, Mississippi Beef Quality Assurance program, Mississippi State University artificial insemination school, Cattlemen's Exchange, Extension beef cattle short courses, Mississippi Beef Cattle Improvement Association (7 web pages including home page, newsletter, bull sale information, bull sale results, Hinds Community College bull test, South Mississippi Gain-on-Forage bull

test, and , board of directors pages), stocker cattle, feeder calf board sales, Farm to Feedlot Program, heifer development, MAFES beef cattle herds, MAFES livestock production sale, Mississippi Animal Disease and Disaster Preparedness Program, beef cattle drought resources, beef cattle hurricane resources, Mississippi Hay Directory, commodity feed sources directory, and Mississippi beef cattle seedstock directory.

The first major expansion of the MSUcares beef cattle website was in 2004. Since then, the website has evolved as beef cattle extension programs have developed and changed over time. The website has also been redesigned twice to improve navigation, organization, and appearance. Website traffic tracking results were obtained using Google Analytics.

Results

Information on website usage statistics and indicators of the quality of website visits for the MSUcares beef cattle website were previously reported in the *Journal of Extension*, *www.joe.org/joe/2011october/tt9.php*. The current report updates that information with 2 additional calendar years of website traffic data. A continuation of the seasonal website use trend initially reported was observed. In general, website page views tended to slow in late spring and early summer and again in December. Page views tended to increase in January and late July. This may correspond to seasonal demands on website user time as well as seasonal offerings, such as webinars or streaming cattle marketing events, on the website itself.

Average Time Spent on Web Pages.

Website usage statistics indicate that the average time spent on web pages within the beef cattle website increased annually through 2011 before leveling off in 2012 (Figure 1). In comparison, the entire MSUcares website experienced a slower rate of increase in average time spent on web pages through 2010 and then decreased for this measure in 2011 and again in 2012. For the beef cattle website, the average viewing time spent per page was 83 seconds in 2007. It was 128 and 127 seconds, respectively, in 2011 and 2012.

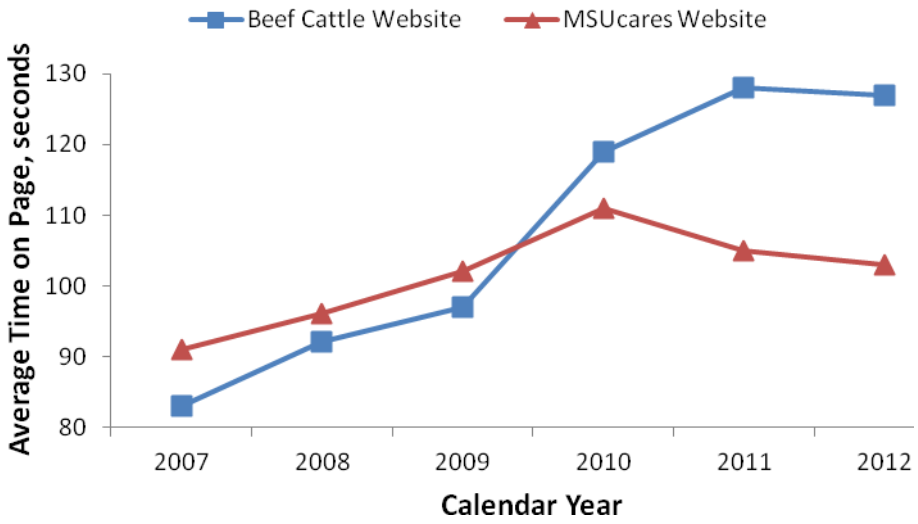

Figure 1. Average time spent on beef cattle MSUcares website pages

The addition of the online directories, Master Cattle Producer modules, webinars, and streaming cattle marketing events to the website may have contributed to the general trend of increased time spent on web pages on the beef cattle website over this period. The Mississippi Commodity Feed Sources Directory web page ranked in the top 3 web pages within the beef cattle website for average time spent on a webpage in all the years examined in this analysis. The Mississippi Hay Directory ranked in the top 4 web pages within the beef cattle website for average time spent on a webpage in half of these years. The Master Cattle Producer web page ranked in the top 5 web pages within the beef cattle website for average time spent on a webpage in 2010 through 2012. The Beef Quality Assurance page, which is a training component of the Master Cattle Producer Program, ranked in the top 4 web pages within the beef cattle website for average time spent on a webpage in 2008 through 2011.

Similarly, the online archives of extension publications, articles, and newsletters have been steadily expanded each year, and may be a current driver in this trend. As evidence of this, the beef cattle publications webpage was ranked first within the beef cattle website for average time spent on a web page in 2012, with an average of 269 seconds spent on this page that year compared with 75 seconds spent on the page in 2007.

Time spent on web pages may also depend upon production conditions. For example, time spent on the drought and hurricane resources webpages tended to increase in years in which these particular environmental conditions were prevalent in the state. Likewise, greater amounts of time were spent on the Mississippi Hay Directory during years in which hay supplies were considered relatively tight.

Website Page Views.

Website views for calendar years 2007 to 2012 are presented in Table 1. The beef cattle website recorded the greatest number of page view in 2007, when it consisted of 44 pages, 11 of which were pages devoted to single frequently asked questions. In later years, the streamlined site did not include these frequently asked questions pages, as that information was incorporated into publications available on the site and more detailed frequently asked questions sections on specific pages such as the drought and hurricane resources pages. With fewer total pages in the site starting in 2008, the total number of page views for the site decreased. From 2009 through 2012, the total number of page views was relatively stable ranging from 48,394 to 52,172 page views.

Table 1. MSUcares beef cattle website page views per calendar year, 2007 to 2012

	Page views		Unique page views	
Calendar year[1]	Number	Percent of MSUcares total, %	Number	Percent of MSUcares total, %
2007	80,766	1.35	47,867	1.06
2008	56,829	0.93	33,072	0.71
2009	50,416	0.86	31,713	0.72
2010	48,394	0.94	31,326	0.81
2011	52,172	1.15	34,984	1.02
2012	49,070	1.07	34,216	0.97

[1]The MSUcares beef cattle website, *msucares.com/livestock/beef*, consisted of 44 web pages in 2007 but was reduced to 30 web pages during 2008.

The number of unique page views, however, increased from 31,713 and 31,326 views in 2009 and 2010, respectively, to 34,984 and 34,216 views in 2011 and 2012, respectively. Unique page views of the MSUcares beef cattle website as a percent of total MSUcares website also increased slightly when compared the same time frame. Unique page views for the beef cattle website currently hovers around 1% of the MSUcares website total unique page views.

From 2007 through 2012, the beef cattle website homepage ranked first for both page view and unique page views. This is expected as it is the portal for the beef cattle website and the uniform resource locator (website address) advertised in beef cattle extension program marketing materials. As of 2012, the top 5 most viewed web pages within the MSUcares beef cattle website were: 1) beef cattle home, 2) Mississippi Commodity Feed Source Directory, 3) Mississippi Hay Directory, 4) Mississippi Beef Cattle Improvement Association, 5) and beef cattle extension publication web pages.

The ranking of each web page within the MSUcares beef cattle website corresponds with Extension programming expansions and updates. For example, a large number of beef cattle Extension publications were developed and listed on the publications page starting in 2008. This

web page rose from the eleventh most viewed page within the beef cattle website in 2007 to the top 6 for this ranking in 2009 and all later years. Similarly, artificial insemination school web page entered the top 10 in the beef cattle page view rankings in 2009 and has stayed there since then, corresponding to efforts to expand, improve, and increase the visibility of this program. To put this in perspective, the artificial insemination school web page was ranked 32nd for page views within the beef cattle website in 2007.

Bounce Rate

Bounce rate refers to the percentage of single-page visits or visits in which the person left a site from the entrance (landing) page. Visitors who enter the site and "bounce" do not continue to view other pages within the site. Bounce rate is an indicator of visit quality, with a high rate indicating that entrance pages are not relevant to visitors. Figure 2 shows the respective bounce rates from 2007 through 2012 for the beef cattle and MSUcares websites. The beef cattle website consistently outperformed MSUcares for bounce rate, providing another indication of its quality in relation to other local Extension websites. The narrowing of the bounce rate gap between the two websites over time, however, may indicate that continued emphasis on website content relevance and navigation is needed.

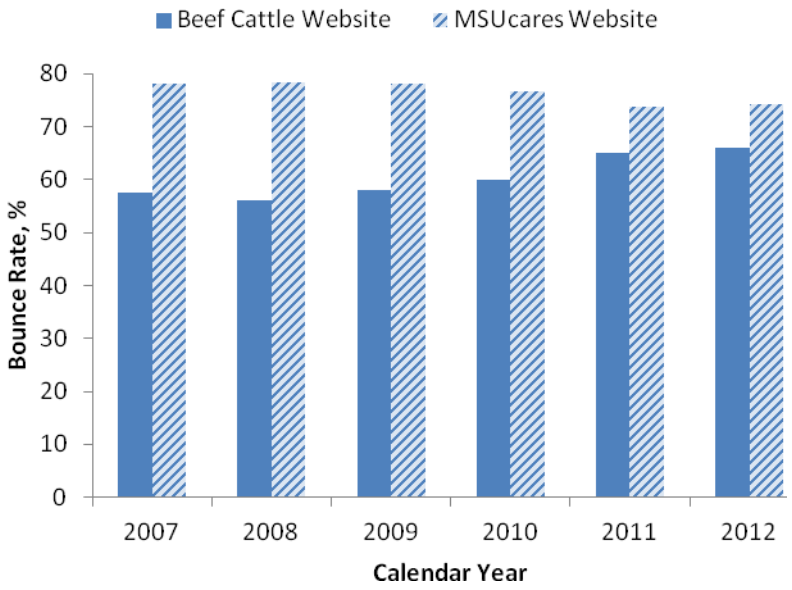

Figure 2. Bounce rate for the beef cattle and MSUcares websites

Implications

The MSUcares beef cattle website is constantly adapting to meet the educational needs of Mississippi's beef cattle industry. Website updates occur at least weekly. Website expansions are routinely undertaken as new educational programs or resources materials are developed. Website usage data show that this website is widely utilized. This information provides guidance for further

development and enhancement of online beef cattle extension programming.

Acknowledgements

Appreciation is extended to Center for Technology Outreach Web Developer, Cindy Callahan, who provided the website traffic tracking reports.

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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 has been continued as an annual event. Boot Camp topics in 2013 included hoof care, calf preconditioning, aging cattle by dentition, crossbreeding systems, clover management, interpreting feed and forage test reports, mineral nutrition, environmental best management practices, and farm equipment maintenance and repairs. 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 at rotating locations.

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 2013, the Beef Cattle Boot Camps were conducted at the MAFES Leveck Animal Research Center on the Mississippi State University main campus and the MAFES Brown Loam Branch Experiment Station, near Raymond, 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 cattle 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. Whereas the novice group was the primary 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 2013 included hoof care, calf preconditioning, aging cattle by dentition, crossbreeding systems, clover management, interpreting feed and forage test reports, mineral nutrition, environmental best management practices, and farm equipment maintenance and repairs. Live animal demonstrations and interactive participant exercises were included in the program. Following the program each participant was encouraged to complete and submit a course evaluation.

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 2013 Boot Camps (n=24) indicated that the information presented would be useful on their operations. They also all 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 4.4, down slightly from 4.6 the previous year. The ratings for individual topics ranged from 4.0 to 4.8. Individual comments were very positive and included useful ideas such as providing a physical address for the Raymond location for persons utilizing global positioning systems to navigation to this host site.

The feedback indicated that the selection of topics for 2013 was appropriate. The topics selected for the 2013 Boot Camps were planned in large part from the suggestions on the participant evaluation forms and verbal feedback from the 2012 Boot Camp attendees. Suggestions from the 2013 Boot Camps for future topics included topics such as marketing programs, expected progeny differences, fencing, forages, and cattle evaluation. These suggestions are also used in planning additional Extension programming efforts beyond the Boot Camps, such as specialized short courses.

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.

Acknowledgements

Appreciation is extended to the MAFES and departmental staff who assisted in Boot Camp preparations and implementation.

Mississippi State University Extension Service Cattle 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. Currently, the topics offered in the school include economics of AI, reproductive anatomy, estrous cycle, estrus synchronization, application of the Estrus Synchronization Planner program, AI equipment, AI technique practice with bovine reproductive tracts, heat detection, heat detection aids, nutritional programs for AI success, sire selection, reproductive heard health, biosecurity, semen handling, and AI technique practice with live 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 Mississippi State University Extension Service (MSU-ES) Cattle Artificial Insemination (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, MAFES Leveck Animal Research Unit (South Farm Beef 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, and limited to 43 participants per course. The participant capacity was expanded in 2012 from the previous capacity of 25 with the addition of the Beef Unit for live animal training. 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 the classroom training. The program requires a minimum of 8 hours of hands-on experience with semen handling and cattle insemination technique. Near the conclusion of the course, 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. For the most recent school in Spring 2013, 27 participants returned completed course evaluations. The overall rating for speakers was a 4.81 and the overall rating for topics was a 4.79.

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 2013 School, consistent with other recent results, overwhelmingly positive responses to these questions were received.

The presentations and interactive demonstrations for the MSU-ES Cattle AI School continue to be 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 included 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, addition of an instructional session highlighting the Beef Reproductive Task Force's free Estrous Synchronization Planner program, 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.

In 2012 additional modifications to the school included expansion of the course to include live animal instruction at the Beef Unit in addition to the Dairy Unit and breakout laboratory sessions in which groups are rotated among reproductive tract handling, AI equipment and semen handling practice, and introduction to estrous synchronization software and breeding box design.

For 2013, the breakout sessions were further divided into 2 semen handling rotations, for a total of 4 sessions to further reduce the number of participants in each breakout group and the student to instructor ratios. Additional instructors were utilized for the chuteside activities as well to better accommodate individualized instruction as needed. Also, new for 2013 was the inclusion of a YouTube video on semen handling.

There remains strong demand for the MSU-ES Cattle AI School. The course is marketed to prospective participants via the MSUcares website and printed brochures disseminated by MSU-ES personnel, and it consistently fills to participant capacity at each offering. Course participation has expanded from primarily Mississippi-based attendees to producers from 18 additional U.S. states. The number of persons that have completed the MSU-ES AI School since its inception in 1997 is now approaching 1,000.

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 to assist them in their educational needs, provide supplemental material after course completion, and use participant input to better the program. Current course information is online at *msucares.com/livestock/beef/aischool.html*.

Acknowledgements

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Mississippi Beef Cattle Improvement Association Activities Update

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Extension Summary

The Mississippi Beef Cattle Improvement Association (MBCIA) has the purpose of unifying beef cattle breeders and promoting beef cattle improvement within Mississippi. In adherence with this purpose, association activities were added and modified in 2012 and 2013 to better accomplish MBCIA goals. Specifically, MBCIA exclusively sponsored the initial printing of the Mississippi Beef Cattle Producer Pocket Guide. Secondly, heifers meeting Miss Premium Heifer Development Program guidelines were added to the spring and fall MBCIA bull sales. Thirdly, MBCIA spring and fall bull sales are now preceded by an evening supper meeting, with the spring meeting being the annual membership meeting. Next, a new classification system was introduced for bull marketed through MBCIA sales to assist prospective bull buyers in sire selection decisions. Finally, MBCIA is scheduled to co-host the Beef Improvement Federation annual convention in Biloxi, Mississippi in June 2015. These activities show that the association continues to evolve to meet the needing of genetic improvement education in an ever-changing industry.

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. 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 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. The MBCIA Fall Bull Sale is hosted annually on the second Thursday in November. 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.

Beyond involvement in cattle marketing programs and centralized bull testing, MBCIA conducts other activities that support its goal of promoting beef cattle improvement. An example includes facilitation of centralized ultrasound body composition scanning of cattle. Recent updates and additions to these activities are presented here.

Procedures

The MBCIA operates under the direction of an elected board of directors. These leaders guide the direction of the association and assist in the implementation of its activities. A complete listing of the current board of directors and other information concerning the MBCIA is posted online at *msucares.com/livestock/beef/mbcia*. The activities highlighted in this report include major MBCIA events in 2012 and 2013.

Results

Pocket Guide Sponsorship

The initial printing of 1,500 bound copies of the Mississippi Beef Cattle Producer Pocket Guide was entirely sponsored by the MBCIA. The MBCIA logo is prominently featured on the back cover of the pocket guide to acknowledge the association's financial contribution towards making this handy field reference available in hard-copy form to the public. This pocket reference was designed specifically for the Mississippi beef cattle industry and has meet with great demand, with the initial printing supply being depleted in 2013 after only being released in 2012.

This 238-page pocket guide features information on MBCIA and genetic improvement as well key information on many other frequently referenced beef cattle production and marketing topics. It was authored by Mississippi State University Extension Service beef cattle specialists. An electronic version of the pocket guide is online at *msucares.com/pubs/publications/p2714.pdf*.

Heifers added to MBCIA Sales.

Beginning with the Spring 2013 MBCIA cattle sale, heifers were added to the sale offering in addition to the tradition of marketing bulls through this sale. Heifers were added to the MBCIA sale to help generate additional interest in the sale offering and attract more prospective buyers to the sale. They were also added to assist in ensuring a critical mass of cattle offered in the sale to justify conducting it and to spread the sales expense across a greater number of lots.

Heifers were required to conform to the Miss Premium Heifer Development Program to qualify for the MBCIA sale. Both registered and commercial heifers were offered through this sale, with the heifers auctioned off following the bull auction at the same facility. Both the spring and fall MBCIA sales at Raymond now include heifers as part of the sale offering; so, these two sales are effectively bull and heifer sales going forward.

Supper Meetings Prior to MBCIA Sales

The MBCIA conducts an annual membership meeting. Historically, this meeting has been held in February in

Jackson, Mississippi, in conjunction with the annual convention and trade show of the Mississippi Cattlemen's Association. An interest in improving attendance at the MBCIA meeting and also further promoting the MBCIA cattle sales spurred the association to revisit the location and timing of this meeting.

Starting in 2013, the MBCIA annual membership meeting was moved to the evening immediately prior to the MBCIA spring bull and heifer sale. A relevant firm was solicited to provide financial support to sponsor a supper for this meeting. An educational program was provided at the meeting as well. The meeting, meal, and program were conducted at the Hinds Community College cattle sale facility in Raymond, the same site as the bull and heifer sale the following day. Meeting attendees were encouraged to view the bulls and heifers on display awaiting sale and interact with the cattle consignors.

The favorable response from the March 2013 annual meeting prompted the MBCIA board of directors to plan a similar sponsored supper, educational program, and sale cattle viewing opportunity on the evening before the fall sale as well. It is anticipated that this format will hold into the near future for both the spring and fall MBCIA cattle sales. Furthermore, the board of directors meetings will be held with these evening meetings to allow board members the time to interact with cattle sale attendees immediately after the sales instead of having to attend the board meetings right after those events.

New Bull Classification System.

A new bull classification system is scheduled to be in effect starting with the Fall 2013 MBCIA bull sale at Raymond. This system is intended to assist prospective bull buyers who may not be proficient in use of expected progeny differences (EPDs) for sire selection. It is designed to both recognize the bulls meeting these classification requirements and to assist potential bull buyers in selecting bulls that best fit their herd sire needs.

Sale bulls will be eligible for the following designations based upon their EPDs: Calving Ease Sire, Terminal Sire, Balanced Trait Sire, and Carcass Merit Sire. Bulls are not required to meet the specifications of any of these classifications to be allowed in the sale. Instead, bulls eligible for one or more of these designations will be recognized accordingly in the sale catalog, on pen signs, and from the auction block.

Implications

The MBCIA has a decades-long history of promoting beef cattle improvement and quality genetics through its activities. The association continues to evolve its activities to meet the needing of genetic improvement education in an ever-changing industry. Besides the examples outlined in this report, a future activity of great significance for MBCIA is its role in co-hosting the Beef Improvement Federation annual convention in Biloxi, Mississippi, from June 9 to 12, 2015.

Heifer Development Workshop

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Extension Summary

The Mississippi State University Extension Service (MSU-ES) conducted Heifer Development Workshop on March 13, 2013 for Mississippi beef producers. The objective of the workshop was to assist beef producers in making good decisions about replacement heifers in their herds. Topics covered in the workshop included: fetal programming and its influences on lifetime productivity, estrous synchronization, nutritional management of replacement heifers, the economics of purchasing vs. raising replacement heifers, genetics and selection tools, health management, reproductive tract scoring, pelvic measurements, and body condition scoring. The workshop wrapped up with a selection challenge which allowed producers to apply what they learned.

Introduction

Replacement heifers represent the foundation for a productive cow herd. They represent the future of the herd, and are key to genetic improvement. In addition, due to recent low cow herd inventories, they are also a very valuable commodity. A workshop featuring presentations, discussions, and practical hands on exercises was held to assist beef producers in improving their decision making about their replacement heifers.

Procedures

The goal of the Heifer Development Workshop was to provide beef producers with the knowledge and tools to improve their selection and management of replacement heifers in their herds. The workshop was offered live at the Bost Theater on the MSU campus. In addition, 4 off-campus locations were offered via a distance video feed at the Central MS Research and Extension Center in Raymond, the Forest County Extension Office in Hattiesburg, the Lafayette County Extension Office in Oxford, and at the Pike County Extension Office in Magnolia.

Advertisement of the workshop was accomplished in several forms. The workshop was advertised in print via brochures and in the Cattle Business in Mississippi magazine. Internet advertisement was also used via msucares.com, the Mississippi Cattlemen's Association Monday Memo, email blasts, and the MSU Beef Cattle Twitter account.

A wide range of topics were covered in this 9:00 am to 3:00 pm workshop. Dr. Caleb Lemley, a reproductive physiologist in the Department of Animal and Dairy Sciences, covered "Fetal Programming", and explained to producers how nutrition provided to the heifer's dam can influence her future growth and reproductive success. Dr. Jamie Larson, also a reproductive physiologist in the Department of Animal and Dairy Sciences,

covered “Estrous Synchronization”, and specific protocols to apply to heifers. Ms. Lyndi Jury, a graduate student in the Department of Animal and Dairy Sciences, discussed “Nutritional Management”, and discussed different strategies to meet production goals for heifers. Dr. Brian Williams, from the Department of Agricultural Economics, went over “Dollars and Cents” of replacement heifer development, and covered budgeting and options for purchasing or raising replacement heifers. Dr. Jane Parish, Beef Cattle Extension Specialist in the Department of Animal and Dairy Sciences, explained “Genetics and Selection Tools”, and explained how genetic selection and the bulls these heifers would be bred to was of utmost importance. Dr. David Smith, from the College of Veterinary Medicine, discussed several topics with the attending producers: “Health Management”, “Reproductive Tract Scoring”, and “Pelvic Measurements”.

Finally, to wrap up the day, Dr. Brandi Karisch, Beef Cattle Extension Specialist in the Department of Animal and Dairy Sciences, demonstrated “Body Condition Scoring” and challenged the producers to apply what they had learned in “Selection Challenge: Applying the Tools.” This session was unique in that producers were provided with actual performance and EPD’s on a group of 8 Charolais heifers. After studying the provided information, the producers then viewed video of the 8 heifers and were tasked with selecting the 4 heifers they would keep for their own herd. Pros and cons of selecting or culling each heifer were then discussed.

Results

Based on responses to evaluations given to each participant at the end of the workshop, all of the responders thought the workshop provided information that would be useful in their operation. All respondents felt that the program was an appropriate length.

Based on a Likert-type scale, where 1= poor and 5 = excellent, the average rating for all workshop topics was a 4.44. The ratings for individual topics ranged from a 4.07 to a 4.83. The speakers were all well received with an average rating of 4.44.

Participants also provided several suggestions for future beef cattle Extension programs. Topics included programs on using genomic selection and more in depth discussion of selection procedures, and more programs on forages and weed control.

Implications

Beef producers are continually seeking more information, and replacement heifer development is a hot current topic in the beef industry. Giving producers the opportunity to apply the information learned in a workshop allows producers to understand how topics covered tie together and how they apply to their particular situation. This should allow producers to better retain the information provided in the workshop.

Fed Beef Challenge

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Extension Summary

The Mississippi Fed Beef Challenge was designed as an educational tool for Mississippi producers who produce freezer beef to evaluate how their cattle performed on the rail. Cattle are harvested at the MSU Meat Lab and producers are provided carcass quality and yield information along with a freezer of beef processed to their specifications. The challenge also gives beef producers the opportunity to see how their beef stacks up compared to other producers.

Introduction

Many Mississippi beef producers often select a calf from the herd to finish for their own freezers. However, most producers do not know how their cattle or their feeding practices have performed. The Mississippi Fed Beef Challenge offers producers the opportunity to discover these two things, and also to discover how their cattle and feeding practices compare to other Mississippi producers. The first Fed Beef Challenge was held in the fall of 2011, and was moved to the spring in 2012. The 2013 contest was held in March, with cattle delivered in late March and carcasses ready for viewing and pick up in April.

Procedures

The format of the contest is informal. Producers are responsible for selecting their own animals, and feeding them until the contest. This leaves the responsibility of determining when the cattle are finished in the producer's hands, and allows the results to demonstrate to the producer how well their feeding and selection practices performed.

Cattle are delivered to MSU over a designated 2-day period. Cattle are held overnight, and harvested at the meat lab facilities the next morning. After a 48-hour chill, carcasses are graded by experienced MSU faculty and priced based on current market grids. Carcasses are available for viewing by producers, and MSU faculty and staff explain each carcass specification and how feeding may have improved or changed carcass quality. After an aging period, carcasses are fabricated based on each producer's specifications.

The contest is open to Mississippi beef cattle producers of all ages. The most recent contest had both entries from both youth and adults from across the state. Most contestants were repeat entries from previous years. Each contestant is only allowed to enter one steer or heifer, and the contest is limited to the first 12 entries due to cooler space limitations. An entry fee of $50 per entry is required, and producers are also responsible for processing fees. The Champion and Reserve Value carcasses received 50 and 30% of the entry fees. Highest Quality and Yield Grade carcasses each received 10% of the entry fees.

One benefit of the contest is that the cattle are also able to be utilized for classes as

well. Steers are evaluated live in Livestock Evaluation. Students are able to view market ready steers and learn to evaluate muscle and fat thickness on the live animal as it relates to the carcass. Students in Meat Science class have the opportunity to witness the harvest, grading and carcass fabrication process

Results

Eight steers were harvested in the 2013 contest. The Champion Value entry belonged to Mills Murphy, a junior contestant. The Reserve Value carcass belonged to Emma Grace Rutherford and was also a junior entry. The Champion carcass also had the highest quality grade, and finished average choice. The carcass with the best yield grade belonged to Danny Martin, an adult entry, and finished with a yield grade of 1.7.

Of the 8 carcasses entered in the contest, 5 reached the choice quality grade, with the remaining 3 carcasses as high select. The 8 carcasses average 0.3 in. of back fat, with an average ribeye area of 12.5 in^2. The average yield grade of 2.25 is exceptional for steers finished to the choice grade. Carcasses were priced based on the current market grid. The average carcass value was $1,265, with the most valuable carcass worth $1,394.

Implications

The Fed Beef Challenge offers beef producers the opportunity to learn more about the results of their freezer beef selection and feeding program. The unique nature of this program allows not only producers to learn, but it also offers an opportunity for MSU Animal and Dairy Science students to learn from these cattle. Feedback and repeat participation in the challenge indicates that the program should be successful in future years.

Extension Beef Cattle YouTube Channel Initiation

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Extension Summary

A YouTube channel was launched in December 2012 by the Mississippi State University Extension Service (MSU-ES). This new YouTube channel (MSUBeefCattle) is accessible online at *www.youtube.com/user/MSUBeefCattle*. Through the first half of 2013, 34 videos were uploaded to MSUBeefCattle and organized into 5 playlists. Tracking features through YouTube allow for detailed analysis of web traffic on this channel. Beyond video view counts, information such as view timing and duration, viewing device type, and geographic location of viewers is available through the channel management dashboard. Initial interest in and response to MSUBeefCattle has been encouraging. Channel viewership is steadily increasing, making this a promising means of disseminating educational information relating to beef cattle production and marketing.

Introduction

YouTube, *www.youtube.com*, is a social media website that allows users to publish videos for public or restricted viewing. According to their website, YouTube receives more than 1 billion unique visits each months, and it reaches more U.S. adults ages 18 to 34 than any cable television network (YouTube, 2013). YouTube allows for extension information to be accessed in an asynchronous manner, without the constraints of time or place (Kinsey, 2010). With growing public interest in this type of vehicle for receiving information, there is a great opportunity for extension educators to utilize YouTube for disseminating information. With desktop video production becoming more feasible with intuitive and affordable software packages, extension educators are increasingly developing YouTube videos and channels as part of their programming efforts (Case and Hino, 2010). The development of the MSUBeefCattle YouTube channel, *www.youtube.com/user/MSUBeefCattle*, is an example of such an extension effort within the Department of Animal and Dairy Sciences at Mississippi State University.

Procedures

The MSUBeefCattle YouTube channel was launched with its first video posting on December 7, 2012. Since then a total of 34 videos were posted on the website through August 15, 2013. Videos were produced by an extension beef cattle specialist using Camtasia Studio® 8 software (TechSmith® Corporation, Okemos, MI) and included a common introduction and ending branding them with the Mississippi State University Extension Service and MSUcares logos and including the tag line "Education for the Beef Cattle Industry – On Demand". The only exceptions to this common production and branding approach were the feeder calf board sale lot videos, which were produced by the Mississippi

State University Extension Service Center for Technology Outreach.

Playlists consist of the following topic areas: Cattle Management, Cattle Reproduction, Cattle Nutrition, Cattle Genetics, and Cattle Sales. Video length ranged from 1 minute 1 second to 9 minutes 1 second. The average video length was 2 minutes 38 seconds, with most of the educational videos being approximately 3 to 7 minutes in length and the feeder calf board sale lots videos being approximately 1 minute in length each. Videos were published to YouTube with tags and brief descriptions.

The MSUBeefCattle channel was advertised through the *Cattle Business in Mississippi* magazine, MSUcares beef cattle website (*msucares,com/livestock/beef*), Mississippi Beef Cattle Improvement Association newsletter, and via extension offices and events in the form of flyers. The MSUBeefCattle Twitter website, *twitter.com/MSUBeefCattle*, also regularly tweets links to videos on the MSUBeefCattle YouTube channel.

The YouTube Analytics feature of the channel manager dashboard was used to access video view and engagement information. This information was assessed over the lifetime of the channel through August 15, 2013. Highlights of this evaluation are presented in this report.

Results

As of August 15, 2013, the MSUBeefCattle YouTube channel had amassed 6,230 video views; 13,645 minutes watched; 33 subscribers; 20 likes; 8 shares; and 6 favorites added. This result is for the first 8 months of the channel's existence. In comparison, the Mississippi Cattlemen's Association (MCA) YouTube channel, *www.youtube.com/user/mississippicattlemen*, was launched on October 26, 2011. As of August 15, 2013, the MCA YouTube channel had garnered 3,021 views and 7 subscribers after nearly 22 months of existence and the posting of 24 videos to the channel.

The top 10 videos in descending order of views and their estimated minutes watched are listed in Table 1. The two most popular videos in terms of number of views were "Freeze Branding Beef Cattle" and "Bull Semen Storage and Handling", with 1,800 and 1,232 views, respectively. Both of these videos also topped the rankings for estimated minutes watched and likes. Of the top 10 videos for estimated minutes watched, the top 3 videos for average percentage of video viewed were: 1) Mineral and Vitamin Feeding Management, 65.3%; 2) Beef Calf Weaning Management, 64.6%; and 3) Freeze Branding Beef Cattle, 62.8%.

Table 1. MSUBeefCattle YouTube channel top 10 videos for views and their estimated minutes watched through August 15, 2013

Video Title	Views	Estimated Minutes Watched
Freeze Branding Beef Cattle	1,800	4,900
Bull Semen Storage and Handling	1,232	3,040
Mineral and Vitamin Feeding Management	598	1,386
Body Condition Scoring Beef Cattle	401	988
Beef Cattle Crossbreeding Systems	387	973
Estimating Cattle Age by Dentition	321	814
Mississippi Cattlemen's Exchange Feeder Calf Board Sale 2013	178	343
Lot 1: 2013 Mississippi Homeplace Producers Feeder Calf Board Sale	147	79
Yearling Cattle Performance Data Collection	127	246
Heifer Reproductive Tract Scores and Pelvic Area	119	312

Channel viewer demographics were as follows. Male viewers accounted for 76.3% of MSUBeefCattle YouTube channel viewership. By geography, the United States was the leading viewer location with 65.9% of the views and 68.1% of the estimated minutes watched. Rounded out the top 5 viewer locations in descending order of percentage of views were the United Kingdom, Canada, Germany, and India. A total of 127 countries were represented in the channel viewership, but the countries not specifically mentioned here each accounted for less than 2% of the views. Within the United States' viewership, the 66.8% of viewers were 45 to 64 years of age.

The YouTube watch page was the most frequently used playback location for the channel's videos, accounting for 68.4% of the views and 64.7% of the estimated minutes watched. Mobile devices were used for 24.7% of the views and 28.8% of the minutes watched. Embedded players on other websites, e.g., the embedded player on the MSUcares beef cattle homepage of the Mineral and Vitamin Feeding Management video, were responsible for 6.6% of the views and 7.5% of the estimated minutes watched. The average view duration was 29 and 25 seconds longer when the playback locations were mobile devices or embedded players on other websites, respectively, as compared with the YouTube watch page.

Traffic sources and their percentage of views in descending order of number of views were: 1) mobile apps and direct traffic, 29.6%; 2) YouTube suggested video, 28.1%; 3) YouTube search, 21.3%; 4) embedded player, 6.6%; 5) YouTube channel page, 6.1%; 6) external website, 5.6%; 7) Google search, 1.8%; 8) homepage feeds and subscriptions, 0.7%; and 9) YouTube other features, 0.2%. The top 5 average viewing durations by traffic source in descending order were: 1) homepage feeds and subscriptions, 3 minutes 5 seconds; 2) YouTube search, 2 minutes 41 seconds; 3) embedded player, 2 minutes 30 seconds; 4) mobile apps and direct traffic, 2 minutes 26 seconds; and 5) Google search,

2 minutes 22 seconds. This information indicates that it may be worthwhile to further target mobile devices for driving future traffic to the channel.

Implications

Initial interest in and response to MSUBeefCattle has been encouraging. Channel viewership is steadily increasing, making this a promising means of disseminating educational information relating to beef cattle production and marketing. View counts for comparable YouTube channels will be assessed by topic to help decide priorities for further video production and publication to the MSUBeefCattle YouTube channel.

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26th Annual Dixie National Intercollegiate Livestock Judging Contest

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Extension Summary

Livestock judging contests help students develop critical thinking and decision making skills, as well as teach students to defend their decisions in a logical manner. Students who participate in livestock judging programs develop skills that last a lifetime, and aid them in their chosen career. The 26th annual Dixie National Intercollegiate Livestock Judging Contest was held on February 10, 2013. The contest saw competitors from across the country including 47 competitors from 6 senior colleges and 62 competitors from 6 junior colleges.

Introduction

Livestock judging contests help students develop critical thinking and decision making skills, as well as teach students to defend their decisions in a logical manner. Students who participate in livestock judging programs develop skills that last a lifetime, and aid them in their chosen career. The Dixie National Contest is unique in that contestants judge only beef cattle, as compared to other intercollegiate contests, which include hogs, sheep, and/or goats as well. This year marked the 26th year of the contest.

Procedures

The judging contest consisted of 12 classes of cattle, divided into 4 different divisions including Market steers, Brahman influenced breeding cattle, English influenced breeding cattle, and Continental influenced breeding cattle. Cattle for the contest were provided by the Mississippi State University Department of Animal and Dairy Sciences, Dickinson Simmental Farm, Madden Farms, 3MS Simmentals, Rafter 4L Limousin, Legacy Cattle Services, Carriere Cattle Company, Bennett Farms, Valley B Enterprises, B & P Brahmans, Little Creek Farms, Bozeman Farms, and Andy Braswell.

Participants were given 12 minutes to evaluate each class of 4 animals before turning in their placing to be scored. Afterwards, contestants were required to defend their placing in 8 of the 12 classes by giving a set of oral reasons.

The contest was made possible with tremendous support from many individuals who volunteered their time as officials, card runners, computer experts, group leaders, cattle handlers, and supervisors. The Mississippi State University Collegiate Cattlemen's Club acted as cattle handlers and group leaders for the contest.

Results

The 2013 contest saw 109 contestants from 6 Senior Colleges and 6 Junior Colleges. Contestants came from Oklahoma State University, the University of Missouri, the University of Tennessee, the University of Arkansas, The Ohio State

University, and the University of Georgia, Connors State College, Redlands Community College, Allen Community College, Lake Land College, Seward County Community College, and Eastern Oklahoma State College.

In the Senior College Division, Oklahoma State University earned top honors as the high point team followed by the University of Arkansas, the University of Missouri, The Ohio State University, and the University of Georgia. The high individual was Taylor Graham of Oklahoma State University, followed by Brock Herren also of Oklahoma State University, Olivia Foster from the University of Arkansas, Dalton Newell of Oklahoma State University, and Matt Merideth of the University of Arkansas.

In the Junior College Division, Redlands Community College was awarded the high point team, followed by Lake Land College, Connors State College, Allen Community College, and Eastern Oklahoma State University. The high individual was Ashley Judge of Redlands Community College, followed by Happy Parsons of Allen Community College, Tucker Mallote of Connors State College, Dirk Murphy also of Connors State College was 4th high individual, and Walter Colvin of Lake Land College was 5th high individual.

Implications

Skills developed through competing in livestock judging contests stick with students throughout a lifetime. The Dixie National Intercollegiate Livestock Judging Contest brought together college students from across the country to compete in this unique cattle only contest. This competition enabled future leaders in the livestock industry to test their skills against fellow students from many colleges and universities.

Mississippi Feeder Calf Board Sales

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Extension Summary

Two Mississippi Feeder Calf Board Sales were held in 2013 where beef cattle producers marketed farm-fresh and assembled stocker cattle. The 5th annual "Cattlemen's Exchange Producer Sale" held on April 2nd in Winona produced 11 truck-load lots while the 6th annual "Homeplace Producers Board Sale" held on August 5th at the Southeast Mississippi Livestock Auction in Hattiesburg generated 18 truck-load lots.

These sales were a collaborative effort among producers, livestock marketers, Mississippi State University (MSU) Extension Service, Mississippi Farm Bureau Federation, Mississippi Beef Cattle Improvement Association, and the Mississippi Cattlemen's Association. With this type of auction format, cattle were not present at the sale facility. Video clips and descriptions of each load were posted prior to the sale on the MSU Beef Cattle YouTube page and broadcast during the sale for prospective buyers. This type of auction offered both the buyer and the seller flexibility in arranging future delivery dates, and offered the sellers the opportunity to market cattle in load lots and command premium prices. For example, the 2013 Homeplace sale saw 700-799 lb steers bring $15.50/cwt over average Mississippi sale barn prices that same week.

Introduction

Since mid-July of 2007, beef cattle producers and commodity support groups have been working to provide a new marketing option for Mississippi feeder cattle. This is a collaborative effort of the Mississippi Cattlemen's Association, Mississippi Farm Bureau Federation, Mississippi State University (MSU) Extension Service, and Mississippi Beef Cattle Improvement Association. After many meetings and input from interested parties, the group developed the annual Mississippi Homeplace Producers Sale in Hattiesburg and the Cattlemen's Exchange Sale in Winona where beef cattle producers could market their feeder cattle.

Procedures

Auctions were managed as board sales by marketing cattle that were not on site. Each lot was represented by video or pictures of the cattle posted on the MSU Beef Cattle YouTube page. Detailed descriptions of cattle type, weight, and management were also posted on the website and distributed to prospective buyers prior to the sale. The same videos and pictures were presented during the auction for buyers in the audience. Arrangements for delivery from the farm of origin to the buyer's location were made after the sale.

Several organizations work closely together to assure that these sales are well organized and presented. The MSU Extension Service played a large role in planning and organizing the sale. Along with Mississippi Farm Bureau representatives, MSU Extension Agents and Beef Specialists gathered consignments and obtained information on cattle lots. The Center for Distance Education was responsible for filming and editing film on all loads of cattle, which were then posted to the MSU Beef Cattle YouTube page. Representatives of the MSU Extension Service, Mississippi Farm Bureau, and the host sale barn were responsible for contacting prospective buyers and providing information on all cattle.

These sales accommodated a large number of feeder calves with the flexibility to arrange for future delivery. Cattle were offered in load-lots made up of single or multiple consignments of uniform calves. Consignments were received from across the state, and loads were assembled with regard to region and type of cattle. Other advantages included reduced shrink, handling, and comingling prior to shipping. The sales also enabled producers to establish reputations that could attract the same buyers year after year, willing to pay more for calves from producers whose cattle performed well in the past.

It was extremely important for the integrity of these sales that all cattle were represented truthfully and accurately. It was also essential that each consigner remained committed to the sale after completing a consignment form. This commitment was not only to the management and buyers but, more importantly, to the other beef cattle producers marketing cattle in this sale. The sales were open to various breed types, cattle weights, and management systems. Implementation of quality breeding programs and best management practices were strongly encouraged for all consignors to help enhance sale results and the reputation of Mississippi feeder calves.

Health management and preconditioning were primary concerns with these types of sales. Consignors were encouraged to complete Mississippi Beef Quality Assurance training. These sales did not require a single preconditioning and vaccination protocol. However, calves that have been managed similarly were grouped in the same load. For example, consigners who vaccinated their cattle with the same products and preconditioned calves for a similar amount of time were grouped together and represented as such.

The first annual Mississippi Homeplace Producers Sale was held in 2008, and continues to be held on the first Monday in August each year. The first annual Cattlemen's Exchange Producer Sale was held in 2009, and continues to be held on the first Tuesday in April each year. Several different livestock markets have represented cattle in these sales over the years, and future sales are open to any interested Mississippi livestock markets and cattle producers.

Results

The Cattlemen's Exchange Board Sale was held on Tuesday, April 2, 2013 in Winona, MS, and hosted by the Winona Stockyard. The total receipts from the sales approached $700,000. Eleven pot-loads of cattle sold (all prices quoted $ per cwt) and

all loads sold with a 2 percent shrink and a $4 to $5 per cwt slide. Mixed loads quote steer weight first, followed by the heifer weight. Steer price is quoted on the mixed loads, while heifer price was $6 per cwt less than the steers.

Feeder Steers:
Bulk Medium and Large 1 and 2:
4 pot-loads 800-825 lbs 135.80;

Feeder Heifers:
Bulk Medium and Large 1 and 2:
4 pot-loads 750-760 lbs 128.33;
2 pot-loads 700 lbs 130.60;

Mixed Feeder Steers and Heifers:
Bulk Medium and Large 1 and 2:
1 pot-load 700 lbs/675 lbs 139.50.

The sixth annual Mississippi Homeplace Producers Feeder Cattle Board Sale was held at Southeast Mississippi Livestock Exchange in Hattiesburg, MS on Monday, August 5, 2013. The sale generated over $1.3 million in total receipts. Eighteen pot-loads of cattle sold (all prices quoted $ per cwt) and all loads sold with a 2 percent shrink and a $5 per cwt slide. Mixed loads quote steer weight first, followed by the heifer weight. The steer price is quoted on the mixed loads; the heifer price was $8 per cwt less than the steers in these loads.

Feeder Steers: Bulk Medium and Large 1 and 2:
2 pot-loads 700-799 lbs 145.00-146.00;
5 pot-loads 800-899 lbs 143.00-147.50.

Feeder Heifers: Bulk Medium and Large 1 and 2:
1 pot-load 500-599 lbs 155.00.

Mixed Feeder Steers and Heifers (steer prices listed): Bulk Medium and Large 1 and 2:
7 pot-loads 600-699 lbs 148.50-156.50;
3 pot-loads 700-799 lbs 146.50-148.50.

Implications

The Mississippi Feeder Calf Board Sales have been successful in bringing together cattle producers and livestock marketers to improve the profitability of both sectors of the beef production chain. Since 2008, more than 19,400 head of cattle in 290 loads have been marketed in these board sales. Together, the receipts from these sales have exceeded $14 million. For more information on these sales visit: *msucares.com/livestock/beef/feedercalf.html.*

Abbreviations List

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)
σ^2 = variance (population)
χ^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

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