
January 22-23, 2008
Holiday Inn
Salisbury, North Carolina
The Dairy Conference is an Annual Educational Program for North Carolina’s Dairy Herd Managers and Dairy Industry Personnel.

The annual dairy conference is sponsored by the North Carolina Dairy Producers Association, and is conducted with the assistance of Dairy Extension Specialists at NC State University.

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School of Agriculture and Environmental Sciences,
NC A&T State University
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NC Dairy Producers Association
NC Dairy Industry Stabilization & Growth Program Strategic Plan
NC Dairy Youth Foundation
NCSU Dairy Foundation
NCSU Dairy Science Club
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Dear Dairy Producers and Dairy Industry Representatives,

The North Carolina Dairy Producers Association is pleased to be sponsoring the 57th Annual Dairy Conference. Working with the Extension Dairy Specialists from North Carolina State University, I feel that we have designed an educational program that will be beneficial to North Carolina dairy producers. I hope that you find the conference beneficial, and that you will gain some new knowledge from the speakers, published proceedings, and the various exhibitors that will be of value to you and your dairy operation.

The NCDPA thanks the agribusiness exhibitors and supporters for their financial assistance in conducting this conference. Their support of this conference and the state’s dairy industry is greatly appreciated. I encourage all producers to take the time to visit the exhibitors and talk with the company representatives.

The N.C. Dairy Producers Association continues to represent the state’s dairy industry in a variety of areas and issues, both at the state and national level. I would like to thank the members for their support, and encourage others to show their support by joining the N.C. Dairy Producers Association.

Again, I hope you gain some helpful knowledge from the Dairy Conference, and that you enjoy your time here.

Sincerely yours,

Norman Jordan, Jr.
President, NCDPA
Dear NC Dairy Producers and Industry Leaders:

On behalf of the Department of Animal Science and the College of Agriculture and Life Sciences at NC State University, I welcome you to the 57th Annual North Carolina Dairy Conference. The program committee has planned an exciting educational program for you. The conference will feature a large trade show this year and conference planners have included time in the schedule to allow you to visit sponsors and their exhibits. You also will have opportunities to visit other producers, educators, and industry leaders. Please take advantage of these opportunities. This conference will definitely be a highlight of the year.

Your NC Dairy Producers Association has become a powerful voice on your behalf with legislators and the general public. Officers of your association devote considerable time and effort working for the interests of the dairy industry. It is important that you attend these types of events and become actively involved with the Association. The Association and its officers must have your input and support to effectively represent you.

Your industry will continue to progress and contribute to the economy and well being of the state and its citizens. The Department of Animal Science continues to provide quality research, teaching, and extension programs to support you and your industry. We consider it a privilege and an honor to help you provide a nutritious, safe, economical product to consumers and to educate young people about the dairy industry and its products and the opportunities available to them in the industry.

Thank you for attending the conference--and for the contributions you make to our department, to the college, and to the citizens of North Carolina.

Sincerely,

Roger L. McCraw
Professor and Department Head
Milk prices were record high in 2007 but so were costs of production. Nevertheless, North Carolina dairy farm incomes should show a marked improvement over 2006.

In 2007, U.S. and North Carolina milk prices set records. On average for the year as a whole, prices were sharply higher compared to 2006 and were significantly above the seven-year averages. The average Federal order uniform (blend) price for 2007 will be close to $20.50 per 100 lb., up about $6.50 per 100 lb. from 2006. Higher prices have provided some relief to North Carolina producers who were struggling to overcome the financial stresses caused by the previous period of low milk prices. However, higher feed, fertilizer and energy-related costs absorbed a sizable portion of the additional revenue.

The effects of the severe drought over much of 2007 also affected farm performance and the effects will spill over into 2008.

Domestic dairy product sales were reasonably good in spite of higher consumer prices. Through November, sales were up 2.4 percent compared to the same period in the previous year. Higher milk prices were largely export driven, the result of tight world markets for certain dairy products and a weakening dollar. Exports of dried milk powders grew strongly throughout the January-October period. World skim milk prices started to weaken at the end of 2007 but cheese prices remain high. Increases in U.S. cow numbers and higher milk per cow combined to raise milk production by 2.2% over year earlier levels and it was fortunate for producers that foreign buyers stepped in and helped absorb this additional milk.

2007 was supposed to be the year we saw a new five-year farm bill passed but that did not happen. The House and Senate each passed different versions of a new farm bill. There are some similarities and some differences in the dairy provisions of the House and Senate versions.

- Price Support Program: Both versions would continue the dairy price support program but propose setting dairy product support prices directly instead of setting a milk support price. Prices would be set at the currently announced levels. The House version would allow support prices to be reduced if government purchases become “burdensome” and hit specified triggers.
- MILC: The House version would extend the current MILC program. The Senate version would modify the current program by increasing the payment percentage to 45% and by raising the production cap on payments to 4.15 mil. lb.
- Federal Orders: Both House and Senate versions would create a Commission to study Federal milk market orders and report back within two years. Both versions include provisions for speeding up the process of amending Federal orders. Both versions also include provisions requiring the Secretary of Agriculture to report on the effects of current procedures for reporting dairy product prices.
• Forward Pricing: Both bills include provisions for a voluntary forward pricing program to be offered by cooperatives but the specifics differ.
• Other: Both versions reauthorize the Dairy Export Incentive Program, the Dairy Indemnity Program and the Dairy Promotion Program legislation.

The House and Senate farm bills will be referred to a conference committee to draft a compromise bill. This compromise bill must then be passed by both chambers and must be signed by the President (who is unhappy with some of the provisions and has threatened a veto unless they are dropped). The 2002 farm bill provisions have been extended until March 15th to allow time for a new farm bill to be enacted. It is unlikely that the provisions of the resulting legislation will affect the dairy outlook for 2008.

The outlook for 2008 is for some growth in domestic sales but forecasts of a weak U.S. economy are a concern. World markets remain tight but there are planned increases in production in many parts of the world so U.S. dairy exports may not match 2007 levels in terms of volume or price. On the supply side, high feed costs and increasing resistance to the use of rBST on the part of dairy processors suggests there will a slowing in the rate of growth in milk production per cow. However, cow numbers have been increasing for almost two years now, in spite of additional buyouts under the CWT program, and this will give considerable momentum to milk production. Opinions about the future course of milk prices vary but prices are expected to decline from current levels as the year progresses. As of January 8, 2008, Class III futures prices are a little above $16.00 per 100 lb. for the end of 2008 compared to over $19.00 for the current month (January, 2008). Overall, a reduction in the average mailbox milk price of $1.00 to $1.50 per 100 lb. for all of 2008 seems likely. For Federal Order 5, this likely means the uniform blend price could decline to $17.50 per 100 lb by the end of 2008 with an average of $19.00 to $19.50 per 100 lb. for the year as a whole.

Corn prices continue to increase, fueled by government policy on ethanol production and the rapid increase in ethanol plant capacity. Forecasts for U.S. average farm prices the 2007-08 marketing year show increases of around $0.60 per bushel over last season’s prices and prices that are up $1.65 from two years ago. High corn prices pull all high energy feeds higher as users look for substitutes to corn. Corn prices also affect the production and prices of other crops as additional acres are pulled into corn production. As a result, soybean prices and soybean meal prices have risen dramatically. Other input costs are increasing too. Energy prices continue to rise, which affects almost all production costs, either directly or indirectly. Nitrogen fertilizer prices continue to increase rapidly.

When evaluating the effects of these price increases on costs of production, it is important to consider how much of an item is used. I recommend estimating the impact on cost of production per 100 lb of milk sold, because this can be compared directly with the milk price received. For example, the effect of higher prices for corn depends on the ration(s) being fed. A $1.00 per bushel increase in the price of corn is equivalent to an increase of $36 per ton; at $2.00/bu. the increase is $72/ton. So if you use 2 tons of corn per cow per year you would see a cost increase of $72/cow/year to $144 per year, respectively, at these prices increases. If you use 3 tons of corn per cow per year your feed costs would increase
$108/cow/year or to $216, respectively. If a cow produces 20,000 lb of saleable milk these increases correspond to $0.36 per 100 lb at $$72 per cow per year up to $1.08 for an increase of $218 per cow per year.

Understandably, given past cost increases, expectations about future cost increases and the historic volatility of milk prices, dairy producers are concerned about the future. My response is that the future will look a lot like the past. **On average**, milk prices **must** and will be higher in the future to cover the increases in cost of production and keep producers in business. However, the key phrase is “on average.” The economic forces at work in the dairy industry have not changed. Milk prices will continue to be volatile and the structural changes (trends) in the dairy industry are likely to continue.

Dairy farm incomes will fall in 2008 but may still be similar to or above the long term average, given normal weather. Prudent financial management still will be required. I continue to see a wide variation among farms and recommend all producers take time to evaluate their financial situation and past performance. Free and confidential help is available. Contact me by phone at (919) 515-5184 or by e-mail at geoff_benson@ncsu.edu.
Wisconsin Dairy Industry
- Overview of WI Agriculture and Dairy
- Economic Impact of Dairy on Wisconsin
- Key to Wisconsin’s Dairy Industry – Infrastructure!

Resources in Wisconsin Dairy Modernization and Expansion
- Resource Contributors
- Resource Flowchart

Wisconsin Dairy Modernization and Expansion
- Initial Dairy Assessment
  - Physical
  - Financial
  - Personal
- Follow Through

Further Resource Listings
Wisconsin’s Agriculture Industry

Overview of Wisconsin Agriculture and Dairy

- Wisconsin’s agriculture industry generates nearly $52 billion for the state’s economy.
- Wisconsin dairy farms produce 22 billion pounds of milk every year, about 13% of the country’s total milk supply.
- Wisconsin cheese plants manufacture more than 2.3 billion pounds of cheese every year.
- Wisconsin is home to 115 cheese plants – more than any other state – that produce more than 600 varieties, types and styles of Wisconsin cheese – nearly double that of any other state.
- Wisconsin ranks number one in the name for dairy farms with 14,500.
- Wisconsin ranks number 1 in the nation for cheese, dry whey, milk goats, mink pelts, corn for silage, oats, forage, cranberries, and snap beans for processing.
- Wisconsin ranks number 2 in the nation for milk production, butter, and milk cows.
- Wisconsin ranks number 3 in the nation for potatoes, carrots, sweet corn, and green peas.

Economic Impact of Dairy in Wisconsin

- Wisconsin’s dairy industry contributes $20.6 billion of revenue annually or in excess of $39,000 per minute to the state’s economy.
- Wisconsin’s dairy industry accounts for nearly 40% of all Wisconsin agriculture jobs, employing more than 160,000 people
- 90% of Wisconsin milk produced goes into cheese
- 90% of WI cheese is sold outside of Wisconsin.
- Wisconsin accounts for more than 20% of the nation’s total dairy exports.
- The average Wisconsin dairy cow generates more than $17,000 a year in statewide economic activity.
- Wisconsin dairy entrepreneurs have made $500 million in private investment to expand and modernize their operations. Dairy processors have also invested $200 million to expand and modernize, opening 23 new dairy plants and expanding 45 more.
Key to Wisconsin’s Dairy Industry – Infrastructure!

- **4,000 Reasons Wisconsin is America’s Dairyland!** Operating a successful dairy operation requires nearby partners you can count on. Count up this list of services available in Wisconsin.

  - **301** Ag Development & Diversification (ADD) grants worth over $5.8 million since 1989
  - **11** Technical Colleges with farm business and dairy herd management programs
  - **1,400** Licensed cheese makers producing world-renown, quality cheeses
  - **700** Dairy 2020 dairy modernization grants for over $1.7 million since 1996
  - **19** Real Estate Companies and Agents specialized in agricultural property
  - **543** Professional Milk Hauling Services for our dairy producers
  - **199** Dairy Processors making dairy products in Wisconsin
  - **1** University of Wisconsin Center for Dairy Profitability
  - **1** Alice in Dairyland promoting Wisconsin nationwide
  - **40** Professional Nutrient Management Applicators
  - **3** University of Wisconsin Agricultural Campuses
  - **76** Dairy Equipment Sales and Service Dealers
  - **75** Custom Calf and Heifer Raising Businesses
  - **31** Dairy Financial Management Consultants
  - **6** Discovery Farms with hands-on research
  - **71** Agriculture Construction Specialists
  - **17** Dairy Facility Design Professionals
  - **43** Wisconsin Master Cheese Makers
  - **314** Agricultural Financial Lenders
  - **170** Dairy Feed Dealers
  - **550** Dairy Veterinarians
  - **1** World Dairy Expo
Resources in Wisconsin Dairy Modernization and Expansion

Resource Contributors

- **Wisconsin Department of Agriculture, Trade and Consumer Protection** – Within this state agriculture agency, the primary group focused on development and expansion is the **Grow WI Dairy Team**. Consultants with specialty in farmstead/direct marketing, large dairy operations management, business and strategic planning, processor/distributor logistics, communications and grant/loan opportunities make up the GWDT. The GWDT has offered over $2 million in grants and loans to producers and processors modernizing facilities. The **WI Farm Center** is a one-stop-shop for most farmer resources offering a herd based diagnostic program, financial planning and analysis, a beginning and transitioning farmer program, and multiple resources for most producers beginning their search for expansion opportunities. Beyond the Grow WI Dairy Team and the WI Farm Center, regulatory groups within the Dept of Ag including; **Animal Health, Food Safety**, and **Agriculture Resource Management** offer additional guidance and information for expanding dairy producers and processors. Marketing support from the “**Something Special from Wisconsin**” and “**SavorWisconsin**” programs also help to promote Wisconsin-made dairy products and increase the awareness of new and expanding processors and artisan cheese makers.

- Wisconsin Department of Commerce – Similar to the GWDT, **Dairy 2020 Program** offers an early planning grant to producers as well as low interest loans specifically for the purchase of dairy cattle.

- Wisconsin Department of Revenue – The **Dairy Investment Tax Credit** is intended to reduce the net cost of durable assets, such as milking parlors, barns, manure handling equipment, feed storage structures, etc., that dairy producers purchase for their operations.

- Wisconsin Housing and Economic Development Authority – Under the **Farm Asset Reinvestment Management (FARM) Loan Guarantee Program**, WHEDA guarantees loans by participating lenders to farmers for the expansion or modernization of an existing farm operation through the acquisition of agricultural assets or the cost of improvements to buildings and land. Additional financial resources are available through the **Credit Relief Outreach Program (CROP)** and the **Agribusiness Fund Program**, which are guarantee loan programs
targeted towards producer purchases of consumable goods necessary to produce a commodity and businesses focused on creating products from raw agricultural commodities.

- **United States Department of Agriculture** – The *Farm Service Agency* offers direct and guaranteed loans for producers as well as services related to financing the expansion of an operation. In particular, Wisconsin has taken advantage of the beginning farmer program offerings, which have provided the capital to early producers for the modernization of older facilities. *Natural Resource Conservation Service* has also been a strong partner in the expansion of facilities assisting producers with meeting the environmental regulatory requirements and providing financial offerings for nutrient management testing and planning.

- **University System** – The *UW-Extension Dairy Team* is comprised of university faculty and academic staff along with representatives from farm organizations and agricultural industries. The Dairy Team develops, designs and evaluates educational programs related to dairy production and management, particularly in areas of herd management, milk quality, dairy workers training, livestock siting, and land use. Along with the extension Dairy Team, the *Center for Dairy Research* and *Center for Dairy Profitability* provide research to improve the quality of dairy products and financial and market viability of WI dairy operations. The UW System also offers 3 *University Research Farms*, located in Madison, River Falls, and Platteville for educational instruction as well as crop and livestock trials. In addition to the 4-year UW System, the UW also offers an agricultural short-course program as well as a *School for Beginning Dairy and Livestock Producers*, which incorporates real-farm applications into classroom instruction. Beyond the UW, the *Wisconsin Technical College System* offers technical degree programs in areas of dairy herd management, farm business management, and other agricultural related areas, which are strong starting points or an advanced degree or continuing education.

- **Local and County Boards** – *Local and County* Zoning boards work diligently with dairy producers and the Livestock Siting Review Board at the WI Dept. of Agriculture to assure expansion is environmentally, socially, and economically viable for the region in which the expansion occurs.

- **Wisconsin Milk Marketing Board** – A strong partner with the GWDT and other dairy groups, the *WI Milk Marketing Board* increases the awareness of Wisconsin dairy and strengthens the
industry through promotion, education, public outreach, industry partnerships, and market development.

- Dairy Business Innovation Center, WI Cheesemakers Association and Specialty Cheese Institute – The Dairy Business Innovation Center (DBIC) is a group funded through the Value-Added Dairy Initiative (the same funding source for GWDT) that offers consultant services to dairy processors, in particular, cheese makers. The DBIC offers a little to no cost services related to package and label development, facility design and layout, product promotion and tradeshow opportunities, financial planning, product development, and market strategizing. Along with the DBIC, groups such as the WI Cheesemakers Association and the Specialty Cheese Institute collaborate on promotional activities and processing development to expand the industry.

- Virtual Networks – Virtual networking groups have been instrumental tools in assembling entrepreneurs, marketing new products in a vibrant industry, and offering timely reference information about expansion and modernization. The Wisconsin Dairy Artisan Network, Grow WI Dairy Team, Grow WI Farmers Working Group and Center for Dairy Profitability are just a few of the many groups utilizing virtual networks.

- Producer groups – Producer organizations such as the Farm Bureau, Farmers Union, Professional Dairy Producers of Wisconsin, Dairy Business Association, Grassworks, and the multiple cooperatives around the state provide addition outreach to dairy producers who are searching for resources to help in their expansion and modernization. Each of the producer groups work collaboratively with each other as well as the university, state, and federal agencies to increase the dissemination of materials and services to aid in dairy expansion.

- Private Sector Professional Resources – Along with virtual networks and producer groups there are thousands of private industry professionals dedicating their careers to the expansion of dairy. Vets, nutritionists, milk haulers/field reps, implement dealers, dairy equipment dealers, genetics firms, utility providers, consultants, engineers, financial institutions – banks, farm credit services, attorneys, and many more are all part of the goal of expanding Wisconsin dairy.
Wisconsin Dairy Modernization and Expansion

Initial Dairy Assessment

Whether it is an extension agent, representative from the Dept. of Ag, or a private consultant working with producers, the initial dairy assessment focuses on the key questions about the current dairy operation as well as goals for both the business and the operator. Advisors will typically direct the assessment in three areas, the physical operation (buildings, land, equipment, labor), the financial well-being (current ratio, cash flow, tax implications, profitability), and personal goals of the business operator (transition to younger generation, merge with a neighbor, reduce risk and liability, increase time away from the farm). Early assessment is a time for exploring options and laying the groundwork for the expansion plan. It is vital to take into consideration both current and potential internal and external factors that can improve or disrupt expansion efforts. Listed below are the three areas of assessment with typical questions and points of information pertaining to expanding and modernizing dairy operations.

Physical

- What is the current state of the following areas:
  - parlor (milking area),
  - housing (calf, dry cow, heifer & and general cattle housing) (ventilation, bedded pack, composted bedded pack, distance in relation to parlor)
  - special needs area (hospital, freshening pens, breeding)
  - manure management (waste holding area, location of waste storage, waste water, ally-way waste)
  - Feed Storage & Feeding (drive by feeding, bunkers, silo, mixers
  - Electrical (lighting needs, larger amperage, updated grounding and wiring to meet code)
  - Water (structure of well, well contamination, ground water)
  - Equipment (hours, will it meet future production needs)
  - Labor (skill set, efficiency)
- How many cows will you be adding to the herd?
• What regulatory measures will you need to meet? (NRCS nutrient management, manure management & storage, siting large animal housing – local, county, & state, AFO’s & CAFO’s)

• How will you improve upon the current state of your facilities to accommodate for growth? What are priority areas? Can this be done without a decrease in efficiency, production or quality?

• Technological advancements (improve efficiency, reduce time and costs, improve production, GPS, precision ag, software programs – Dairy Comp 305)

Financial

• What are the current and projected cash flows?

• What is your Current Ratio? (Assets / Liabilities)

• What is your Quality of Income? (Cash Flow from Operating Activities / Net Income)

• What is the strength of your working capital?

• Financing? Financial leverage? What are sources for borrowing? (FSA, Farm Credit, local bank, what are current interest rates)

• What are current and projected operating expenses? (As the operation is now and with the determined level of expansion) (Feed, crops, rent, utilities, repairs, labor, benefits, veterinary, breeding, replacements, insurance, taxes)

• Are there other areas of investment?

• Do you have a business plan? (Is it up-to-date, realistic assumptions, conservative milk prices, factored in culling rates or replacements)

Personal

• Where do you see yourself and your operation in 5, 10, 15 years?

• Does the operation have a successor?

• Is there a transition plan in place to direct management from one party to another?

• What is the overall goal of your expansion? (Increase production, increase viability of operation, increase labor efficiency, decrease production costs)
Follow Through

- Producers, extension agents, regulatory specialists, consultants and contractors must all work together as a team in order to follow through with the initial assessment and commence the actual expansion work.
- It is important for the team to adhere to the time line in order to stay on task, eliminate inconsistencies, and reduce costs.
- Assessment is a work in progress, so it is essential that the team revisits initial outlines and goals to measure progress and adjust to changes in the market and operation.

Further Resource Listings

- Wisconsin Department of Agriculture, Trade & Consumer Protection
  www.datcp.state.wi.us

- Grow WI Dairy Team
  www.growwisconsindairy.org

- Dairy Business Innovation Center
  www.dbicusa.org

- Wisconsin Milk Marketing Board
  www.wisdairy.com

- Wisconsin Department of Revenue – Dairy Investment Tax Credit Program
  www.dor.state.wi.us/faqs/pcs/dairy.html

- Wisconsin Department of Commerce – Dairy 2020 Program
  http://commerce.wi.gov/BD/BD-AgriBusiness.html

- Wisconsin Housing and Economic Development Authority
  www.wheda.com/sb_ag.asp

- Center for Dairy Profitability
  www.cdp.wisc.edu/

- Center for Dairy Research
  www.cdr.wisc.edu

- Wisconsin Cheesemakers Association
www.wischeesemakersassn.org

Specialty Cheese Institute
http://www.wispecialcheese.org/

University of Wisconsin Dairy Department
www.wisc.edu/dysci

School for Beginning Dairy and Livestock Producers
http://www.cias.wisc.edu/dairysch.html

University of Wisconsin – Extension
http://www.uwex.edu/ and cooperative extension at http://www.uwex.edu/ces/
The North Carolina Dairy industry Stabilization and Growth Program
Strategic Plan Executive Summary

“DAIRY ADVANTAGE” - North Carolina, Where Opportunity Abounds!

Dairy industry leaders identified the needs and developed a Strategic Plan for North Carolina’s Dairy Industry Stabilization and Growth Program. These leaders, representing milk producers, milk processors, allied dairy businesses, farm organizations, North Carolina Department of Agriculture & Consumer Services, and NC State University Extension Specialists, created an action plan to meet four major goals for North Carolina: 1. enhance the value of milk and dairy products produced in the state; 2. enhance the dairy farm family quality of life; 3. increase the volume of Grade A milk produced in the state; and 4. support the dairy farm numbers in the state.

The NC General Assembly came forward with new legislation to support its findings that “Sustaining and growing North Carolina’s dairy industry will advance the State’s goals of preserving and enhancing its economic base and improving the quality of life in the State through maintaining green space and water quality and assuring an adequate local supply of fresh milk.” A strategic planning committee, after considering a number of strategies to support farm retention, dairy farm expansion, and relocation and recruitment of in-state and out-of-state dairies, developed a strategic plan with the following key action items:

- Develop a farm assessment program for existing producers to help them identify strengths and weaknesses
- Develop a dairy profit team program to help producers improve the long-term viability of their dairy farms
- Establish a recruitment and relocation assistance program for individuals interested in establishing dairies in North Carolina
- Establish a Dairy Development Coordinator position to assist with the development of the North Carolina dairy industry
- Encourage and assist NCDA&CS to create staff responsibilities specifically in Dairy Agribusiness
- Encourage and assist NC Cooperative Extension Service to maintain two Area Specialized Dairy Agents, and to convert these positions to be fully state funded
- Encourage and assist NCSU College of Agriculture and Life Sciences to maintain an effective dairy extension program in production, management and economics
- Establish a legal entity with several purposes, one being to obtain resources to accomplish the goals and action items included in the Strategic Plan

“America’s dairy industry is more than milk. It is jobs and economic activity for the people of our country.” North Carolina’s dairy industry has been identified as a vital component to the state’s economy and our future quality of life. The Dairy Advantage Strategic Plan is the committee’s recommendations of how to protect the existing dairy industry, grow the industry in the future, and strengthen the cooperative relationships that will promote a reversal of the trends in dairy farms in North Carolina.
Dr. Mitch Hockett, Assistant Professor, NCSU Department of Animal Science, wrote a three article series on Mycoplasma Mastitis for the North Carolina Dairy Extension Newsletters. Those articles are reprinted below for your review and use.

**Mycoplasma….Preparing for Battle**

Recently an experienced dairyman told me that dairy farming is a constant battle against a monster, and you must get up and fight the monster every day to have a chance to win. Comparing a dairy farm to a monster may not appeal to many people, because it is an industry that we “love.” How quickly can a relationship turn from “love” to a “love-hate” relationship? Ask anyone who has had an outbreak of Mycoplasma mastitis, and they will probably be quick to tell you the “hate” side and about what a real monster looks like. In this article, the first in a series of three, I will discuss general information about this mostly unknown threat to the dairy industry.

"Know thy enemy and know yourself; then in a hundred battles you will never be defeated. When you are ignorant of the enemy but know yourself, your chances of winning or losing are equal. If ignorant both of your enemy and of yourself, you are sure to be defeated in every battle." This quote from the ancient Chinese general Sun Tzu can be applied to many situations, but is especially true to Mycoplasma mastitis. Just when you think you know everything there is to know about mastitis, along comes another class of pathogen to worry about. Step one: get to know your enemy.

The term mastitis comes from the Greek word mastos, meaning breast, and “-itis,” meaning inflammation. Mycoplasma mastitis is caused by one of the Mycoplasma species of pathogens. Normally one thinks about mastitis being caused by bacteria, and occasionally a fungus or virus. However, mycoplasma are different from all of these categories. These microbes have a structure that is unique but intermediate between bacteria and viruses. Mycoplasma have no wall surrounding the outside of the cell as is found in a bacterium. Dairy farmers are all too familiar with the term Gram-negative bacteria. Just hearing those words or E. coli can raise the hair on the back of your neck. Mycoplasma are neither Gram-positive nor Gram-negative. They cannot be classified by this method due to the absence of a cell wall. Why does this matter? Many of the antibiotics that have been used to successfully treat mastitis infections are able to kill bacteria by interrupting the cell’s ability to produce a cell wall, but these antibiotics are useless against mycoplasma.

Most species of mycoplasma gain entry into the body through the respiratory tract. In this location the cell membranes that surround the mycoplasma comes in contact with the membrane of another cell or tissue and adhere to it in a process called cytadhesion. There are different species of mycoplasma, and it appears that they are all different in their ability to adhere to and colonize different tissue types. *Mycoplasma bovis* is found in parts of Europe and North America, is quite capable of adhering to and colonizing tissues, and is responsible for diseases such as mastitis, pneumonia, and arthritis. Mycoplasma have been recovered from the trachea, respiratory tract, saliva, semen, vagina, mammary glands, ears, joint capsules, and other locations from cows, heifers and bulls. And the battle begins….
Due to their ability to colonize the respiratory tract, mycoplasm may cause pneumonia. Outbreaks of pneumonia in calves and cows have been documented to occur primarily during times of stress. In the North these occur mostly during winter and in the South they occur mostly during the summer. Respiratory outbreaks in cows typically precede mastitis outbreaks.

**Mycoplasma in Cows:** Mycoplasma mastitis was first reported in 1960 in England and 1961 in the United States. Most reports of this type of mastitis include descriptions of cows that have swollen, hot quarters with milk that has clots, flakes or clumps and milk that becomes discolored with the progression of the infection. These infections become chronic and do not respond to treatment. Cows appear to clear the infection with treatment, but relapse repeatedly. Most cases will spread from one quarter to other quarters on the same animal. Additionally, mycoplasm is extremely contagious and will spread from animal to animal. Within an animal it may spread from the lungs to the mammary. Perhaps the most frightening thing about this monster is when an outbreak occurs on a farm it is not usually limited to one or two animals. Depending upon the size of the herd, outbreaks of mycoplasm may claim tens to hundreds of animals.

**Mycoplasma in Calves:** As stated previously, mycoplasm have been isolated in saliva, from the vagina, and from milk of infected animals. Therefore, it should come as so surprise that calves from infected cows frequently also become infected. Contamination may occur in the birth canal, from being licked by the mother after birth, or primarily from drinking infected milk. Feeding unpasteurized whole milk to calves can prove problematic. A study on one farm in Florida reported that 23 calves on the farm were negative for mycoplasm at birth, but all were positive by 23 days of age with the majority being positive by 12 days of age. One half of those calves developed clinical symptoms of mycoplasm infection. Clinical symptoms found commonly in calves include inner ear infections with head tilt, swollen joints and arthritis that may be crippling, diarrhea, and pneumonia. Mycoplasm are sensitive to temperature and may be killed by proper pasteurization; however, pasteurization failures have been reported to be followed by outbreaks of these clinical symptoms. Heifers that are infected show poor growth and must be treated with costly antibiotics. To further add to the problem, most antibiotics are not effective against *Mycoplasma bovis*.

As General Tsu pointed out, we must know our enemy. In the next issue I will discuss about knowing “yourself”, your farm, and what to do if you find yourself in the middle of this battle, or ways to prepare for war before it is brought to your farm. Prevention is the best solution, but there are ways to fight the battle when it comes.

**A Call to War…..When Mycoplasma Strikes**

Recently I was in a discussion with a colleague at Louisiana State University, and she was telling me about a producer in her state who lost his entire farm due to mycoplasm. The more you discuss this topic with producers around the country, the more you realize how
common an issue it is. Why, then, do we seem to know so little about it? One answer may be that the people who have dealt with it prefer not to ever mention it again. My goal in this series of articles is to prevent someone from being caught unaware. From experience, I can say that I have witnessed the physical damage done to the cows, as well as the mental, physical, and financial damage that mycoplasma may bring to the individuals who work with the cows on a daily basis.

In the first article I wrote about the enemy “mycoplasma” and some about how they differ from typical bacterial pathogens that cause mastitis. I also discussed some symptoms of myco in calves and cows. In this issue I will discuss about taking a closer look at yourselves and the current situation that exists on your home farm. The approach will be to ask yourself a series of questions. Answer them honestly, or you will be the only one being fooled.

First of all, **do you have a closed herd?** I think the best way to define a closed herd is one that has not brought animals in, and does not allow contact with animals from other dairies. Some may take a more aggressive definition to limit contact by people from other farms, but this is quite extreme. In this day of dwindling dairy numbers and necessary expansion to survive, most dairies have purchased animals from somewhere. If you are one of the few who have grown internally, then congratulations! For the rest of you, it is likely that you have mycoplasma on your farm. This does not mean that you have active infections and shedders or that every case of mastitis you see is myco, but it does mean that you need to be aware that usually farms bring myco in when animals are purchased or through contact with other infected animals. It would appear that downsizing is not an option in the industry, so large animal purchases will continue. Therefore, we must become educated about the animals that are purchased. Screen animals before they are bought. When possible, buy groups from a known source and have animals tested before they are purchased. At the minimum, do a bulk tank sample and if possible, screen milk from every animal. If you can stop myco at the door it will be worth the expense of testing the animals 1000 times over.

**Have your cows had unexplained mastitis cases that persist after treatment? Or, do cases appear to clear only to come back time after time?** If so, then there are several pathogens that could be the culprit. Every case of chronic mastitis is not due to mycoplasma. Milk samples should be taken from mastitic quarters before treatment and cold stored until microbiology can be performed to determine the causative pathogen. This is a good practice for farms regardless of mycoplasma. Knowing the pathogen profile for a farm is priceless information, and knowing what antibiotic is effective against a pathogen is even better. Microbiology can give you this information and many veterinary practitioners in the state are equipped with laboratories to give you this information. The state veterinary lab and NCSU College of Veterinary Medicine have these services as well. Many producers hesitate because it costs money to run a milk sample. Ask yourself this question: How much money do I pour down the drain every day that I treat a cow for mastitis and she doesn’t get better? If you answer this honestly, the cost of the microbiology will prove minor, and the information could save you money in the long run. Additionally, bulk tank samples may be run to determine if myco is present in the herd already. If so, you may choose to sample strings of cows to narrow down to the infected individuals, and therefore
you save money by not sampling every cow in the herd.

Do you detect many cases of pneumonia in your herd or in your calves that do not seem to respond to typical treatments? Mycoplasma often first rears their ugly head as respiratory infections. They can spread from cow to cow in this way, and do not have to colonize the mammary to spread. Calf loses can be tremendous if a treatment protocol is not established quickly. Cows may also die from mycoplasma infections in the respiratory system. Nasal swabs can be cultured to determine pathogen type. Producers may wish to have animals that die from pneumonia like symptoms posted to determine cause. Again, you may contact your local veterinarian, the state lab, or NCSU college of veterinary medicine for assistance. Remember that calves with mycoplasma often show a drooped ear due to infection in the ear, and if not treated, this may result in a tilted head. Be familiar with the signs so that your response may be quick.

These are just a few questions that you may want to ask to get to know your own situation a little better. Many producers are surprised by the answers they get, even though they thought they were doing everything right. After all, what is wrong with buying animals and bringing them to your farm? The answer could be “nothing” or it could be “everything”. Producers who have survived outbreaks on their farm would typically change their management decisions if they could do it all over again. Take some time to look at your operation in the mirror and see if you are prone to a mycoplasma outbreak, or are you in the middle of one?

In the next article I will outline management strategies for dealing with an outbreak of mycoplasma with feedback from individuals who have come through the fight.

Winning the War with Mycoplasm

Farms that have survived a Mycoplasma outbreak may question the above title. Does anyone truly win any battle that ravages the farm and leaves tens to hundreds of animals infected, stunted, blemished, or even dead? The previous two articles have focused on learning about Mycoplasma and taking an unbiased look at your own operation to determine susceptibility to infections, or if an outbreak is already occurring. In this final segment of the mycoplasma series we will discuss management strategies for dealing with Mycoplasma that have been recommended by professionals or by individuals who have come through the fight.

A recent trip west allowed me the opportunity to visit with two managers of one of the largest dairy farms in Idaho. When the topic came up, both managers admitted that the battle with mycoplasma had taken residence at their farm. The 23,000 cow operation is broken down into dairy units that range in size from several hundred to the largest at 14,000 cows. Expansion has been a must in order to reach their target herd size, therefore herd purchases have become regular occurrences. Since realizing that Mycoplasma was becoming an issue on the farm, testing has been implemented for all cows that are purchased as soon as they arrive on the farm. When asked if mycoplasma is an issue in their area, both were quick to point out that “if someone says that they don’t have
mycoplasma on their farm then they probably haven’t checked for it.” The two reported that approximately 10% of the animals they purchase test positive for either Staph or Mycoplasma when they arrive at the farm. The same trend has been experienced by several expanding herds in North Carolina.

This, coupled with the fact that there is no known cure for Mycoplasma in lactating dairy cattle, is reason that the best strategy to win over mycoplasma is to stop it before it gets into the farm. Testing is key to preventing large-scale outbreaks. Animals should be tested before purchase or at time of arrival on the farm before co-mingling with the existing herd. Cows that test positive should be separated immediately into a suspect herd and a second test performed for confirmation. At this point a decision must be made. Do you cull cows that test positive for mycoplasma? Early on, this question may seem easy to answer, especially for an animal that is infected with mastitis for the fifth time this lactation. What about an animal that shows no clinical symptoms? Each animal presents a different case, and producers vary in their criteria of when to cull. Most extreme is the thought that all positive animals must be culled. On the less conservative side is the idea to manage those animals separate from the rest of the herd, always milking them last through the parlor, and never allowing them access to other animals.

There are those who believe that infected animals can be turned dry and allowed to “self-clear” from the infection. There are published reports of cows that have successfully cleared mycoplasma from their system, but there are far greater numbers of animals that did not clear the infection. A herd in North Carolina chose to dry off 33 pregnant animals that were confirmed to carry mycoplasma. Of the 33, only four tested clean at the next calving. The danger is the damage that one infected cow can do to a group of uninfected animals. This we know to be true, mycoplasma are highly infectious. They can gain entry to the body through the mammary or through the respiratory system, meaning the infected animal with pneumonia may infect others around her even if she is not lactating. For this reason, many people recommend that all positive animals be culled.

If infected animals are kept, they must be isolated from the remainder of the herd. Furthermore, these animals should not be stripped routinely before milking. Pre-stripping these animals often leads to exposure of non-infected animals to Mycoplasma. Additionally, individuals who are pre-stripping these cows should wear gloves and change gloves with each animal. The infected group should be milked last to decrease exposure to other animals. Mycoplasma may also result in pneumonia, especially during times of stress. Cows detected to have pneumonia very early may often be treated successfully. However, less success is achieved when treating animals that are detected late with severe pneumonia. Some producers choose to sell these animals immediately.

Calves that are infected typically show ear droop and a tilt head due to ear infection. These animals often become thin and grow very poorly. Furthermore, they frequently experience pneumonia, which may be complicated with severe, crippling arthritis. Calves that exhibit drooped ear may be treated by washing ears with hydrogen peroxide while massaging the peroxide at the base of the ear. If initiated early enough, this treatment twice daily until symptoms subside has been effective to restore ears and relieve the ear infection.
Furthermore, treatment combinations with extended antibiotics have cleared calves from Mycoplasma. One must realize that few antibiotics are effective against myco, and severe cases typically lead to death of the infected animal.

There is no definitive method that one can use and be guaranteed success for managing mycoplasma. The best success is achieved when infections are prevented before occurring. Treatment in calves is most successful when diagnosis occurs early during the infection. Eddie Patrick, a respected North Carolina dairyman, recently said “the more we learn about mycoplasma, the less we seem to know” and indeed mycoplasma are terribly frustrating due to their lack of similarity to typical bacterial or viral pathogens observed on dairy farms. Research continues to increase our understanding about this pathogen and will hopefully lead to greater future success in this war.
Antibiotics and supplemental fat are fed to high producing cattle to improve feed efficiency. Their metabolic effects are similar and well known, but it is not clear how they alter the microbial populations in the rumen to achieve these effects. The objective of this study was to investigate microbial population changes in response to the antibiotics monensin (M) and bacitracin (B) and supplemental fat in the form of oil (O). Mixed cultures of rumen microbes were incubated in artificial fermentors for a total of 16 d. Each run consisted of 6 fermentors. One served as a control (C) and received alfalfa hay, while the other four received one of the following four treatments; 1) monensin then oil (MO), 2) oil then monensin (OM), 3) bacitracin then oil (BO) and, 4) oil then bacitracin (OB). Each run was replicated three times (n=3). Fermentation variables measured were volatile fatty acids (VFA), total cell number, methane production, culture pH, ammonia (NH₃), and long-chain fatty acids (LCFA). Samples were also taken to analyze the microbial population using terminal restriction fragment length polymorphisms (T-RFLP).

There were no significant changes in the fermentation parameters in C. As expected, both M and O reduced acetate (p<0.01), increased propionate (p<0.05), and decreased methane production (p<0.05). Bacitracin did not alter acetate or propionate but reduced methane (p<0.05). The sequence of additive supplementation did not alter rumen fermentation, but it did seem to cause differences in the microbial populations. The T-RFLP of C shows an adaptation to the in vitro system before d4 and indicates a decrease in diversity occurring between d10 and d16. There were differences between M and B in diversity and in divisions at the Class level, reflecting the different mode of action of the two antibiotics. M and O were also different from each other, suggesting the additives affect different microorganisms. Furthermore, the sequences in which the additives were supplemented affected the microbial populations.

INTRODUCTION
Cows in peak lactation are fed supplemental fat and ionophores to help meet their tremendous metabolic requirements. Individually, these additives increase the efficiency of the diet. Fat or oil (O) provides a more energy dense diet without requiring a fiber reduction and ionophores improve the feed:gain ratio. Both O and M improve the fermentation profile, as they decrease A:P and reduce methane production. Because of their ability to alter the fermentation of the rumen, O and M likely have effects on the microbial population. Supplemental fat may physically coat fiber with fat, bind to microbial cells and affect the cell membranes, and may change competition, and thus the populations, in the rumen. Monensin is most active against Gram (+) bacteria, which lack much of the protective outer membrane that makes Gram (-) bacteria less susceptible to the antibiotic. Bacitracin (B), is a cyclic peptide that can also result in similar effects as M. It also acts on Gram (+) bacteria but unlike M, it inhibits cell membrane synthesis. Bacitracin has fermentation effects similar to M, but its effects are during growth of the cell.

Although M and O have beneficial affects on fermentation when fed alone, studies have shown that when fed together, they may not always improve efficiency. The objectives of this study were 1) to determine the effects of antibiotics and oil on rumen
fermentation and 2) to monitor the effect of the additives and the sequence of the additives on rumen microbial populations. It was hypothesized that although the changes in fermentation by M, O, and B are similar, they have different effects on the microbial population of the rumen due to their different mode of actions.

MATERIALS AND METHODS

Rumen fluid collection and fermentor set-up

Rumen fluid was collected from a ruminally fistulated non-lactating Holstein cow consuming a forage diet and housed at the North Carolina State University Dairy Educational Unit. This study was approved by the North Carolina State University Institution of Animal Care and Use Committee. Approximately seven liters of fluid were sampled from various sections in the rumen using a manual hand held pump and, along with a handful of rumen digesta, placed in a sealed, preheated cooler and transported to the laboratory. Once in the lab, the fluid was filtered through double-layered cheesecloth, mixed thoroughly, and 700 mL were added to each of five dual-flow fermentors.

Several hours before the addition of ruminal inoculum, the fermentors were purged with CO₂ to displace any oxygen, heated to 39°C, and the saliva line was primed. Throughout the trial, the water bath maintained the fermentor temperature at 39°C, CO₂ flow was set at a constant rate at 20.0 ml/min, and artificial saliva was delivered with a precision pump at .73mL/min that resulted in a fractional liquid dilution rate of 6.8%/hr. The fermentors were continuously mixed at 10 rpm.

Experimental Protocol

Dietary Treatments

The trial schedule is shown in Table 1. A 100% forage diet consisting of alfalfa pellets was fed in equal portions at 0700 and 1400h, for a total of 13.5 g of feed (DM basis) per day. The fermentors were allowed a 4 d stabilization period, during which time all fermentors received a 100% alfalfa pellet diet. On d5, two fermentors received soybean oil (O) at 5% of diet DM, one fermentor received M at 22ppm of diet DM, and one received B at 22ppm. These dietary treatments were monitored for 6 d. On d11, one of the two fermentors that received 5% O also received M (22ppm) and the other fermentor received B (22ppm). The other two fermentors that received only M or B then received 5% O. These diets were allowed to ferment for an additional 6 d. Each run consisted of a total of 6 fermentors. One fermentor was used as a positive control (C) and received 100% alfalfa pellets throughout the experiment. Each run was replicated 3 times. Alfalfa hay used in this experiment consisted of pellets and was purchased from a local feed store. M and B were purchased from Sigma Chemical Co. (St. Louis, MO), and O (Wesson brand) was purchased at a local grocery store. At time of mixing, one kilogram of alfalfa hay per diet was added to a blender and 22mg of the respective antibiotics were added to yield a concentration of 22ppm. The diets were thoroughly mixed to assure complete distribution of the antibiotics. The feed was deposited in the liquid portion of the contents. Supplemental fat (375µl) was added directly to the fermentors at each feeding via a long Pasteur pipette.

Sample collection and analytical procedures

Samples for cell counts were collected on d4, 5, 9, 10, 11, 15, and 16. Samples for VFA, LCFA, ammonia, and T-RFLP were obtained two hours after feeding on d4 (the last
day of adaptation) and d10 and d16 (the end of each dietary treatment). Methane and pH were measured daily. Prior to sampling culture contents, the speed on the automatic stirrers was increased to thoroughly mix fermentor contents. A pipette with a large opening was used to obtain a homogenous sample.

**T-RFLP analysis**

A 10 mL sample was taken from the inoculum and on d4, 10, and 16, 10 mL samples were taken from each fermentor two hours after the morning feeding and stored at -70°C until analysis for T-RFLP. Samples were thawed and DNA was extracted with the PowerSoil™ DNA isolation kit (MoBio Laboratories, Inc.; www.mobio.com). A 1µl sample of each genomic DNA (gDNA) was run on a 1% agarose gel at 120 volts for 60 minutes. A PCR was performed on 1µl of the purified gDNA using the bacterial primers 8f(5'-AGAGTTTGATCCTGGCTCAG-3') and 1492r (5'-GGTTACCTTGTTACGACTT-3') and the archaeal primers AR109F and AR912R. Each PCR reaction consisted of 100µls, containing 10µls 10X buffer, 0.8µls dNTP, 0.5µls forward primer, 0.5µls reverse primer, 0.5µls taq polymerase, 86.7µls PCR grade water, and 1µl gDNA. The PCR was performed on an iCycler® (Bio-Rad Laboratories; http://www.bio-rad.com) and the program began with 3 minutes of denaturing at 94°, followed by 25 cycles of 94° at 1 minute, 50° at 1 minute, 72° at 2 minutes, followed by 7 minutes of extension at 72°. One µl of each PCR reaction was run on a 1% agarose gel at 120 volts for 60 minutes.

The reactions were purified using the UltraClean™ PCR Clean-up Kit (MoBio Laboratories, Inc.; www.mobio.com) and 1µl of each purified PCR reaction was run on a 1% agarose gel at 120 volts for 60 minutes. The remaining 49µls of the PCR products were then digested in three separate reactions. Each of three tubes contained 15µls of the purified PCR reaction, 74µls of PCR grade water, 1µl of one of three enzymes: Rsal, MspI, or Hhal, and 10µls of its corresponding buffer. The Hhal reaction required 1µl of BSA and contained 73µls of water. All enzymes were purchased from New England BioLabs (http://www.neb.com). The digestion reactions were incubated overnight at 37° and heat killed by immersing in a 60-70° water bath for 20 minutes. The reactions were purified using the QIAquick Nucleotide Removal Kit (Qiagen, Inc.; Valencia, CA) and eluted with 50µls of heated PCR grade water. Samples of 20µls from the purifications were run on a 1% agarose gel at 120 volts for 60 minutes. The remaining 30µls of the samples was wrapped in parafilm and stored at -80°C until shipped to the Genomic Technology Support Facility at Michigan State University for analysis on an Applied Biosystems Prism 3100 Gene Analyzer (Applied Biosystems; Foster City, CA). The resulting data files were uploaded and filtered so only information associated with the added fluorescent tag remained. The resulting fragment patterns were analyzed using InSilico, Inc (http://www.insilicoinc.com/).

**Statistical analysis**

All fermentation data and total cell numbers were analyzed using the Proc Mixed procedure of SAS. The random variable was the rep and the significance is reported at p<0.05.

**RESULTS AND DISCUSSION**

**Description of data generated from T-RFLP analysis**

The total unique fragments were enumerated using the T-RFLP generated by
digestion with *RsaI*, *HhaI*, and *MspI*. Every combination that included one fragment from each digestion created a unique fragment pattern, which may correspond to a unique species. The fragment pattern does not reveal the organism number per species, but does provide information on the diversity of the population. The percentages of fragments not utilized by the InSilico database (unmatched fragments) are presented in Table 2. Discarding the highest and lowest percentages for each enzyme resulted in averages of 84%, 92%, and 90% for the *RsaI*, *HhaI*, and *MspI* generated T-RFLP, respectively. The highest utilization of fragments was 100% of the *HhaI* digested BO sample, followed by 98% of the *MspI* digested Cd4 and B samples, and 95% of the *RsaI* digested O sample. The lowest utilization of the *HhaI* generated fragments was from the M sample (79%) and the lowest from the *MspI* fragments was from the MO treatment (69%). The *RsaI* digested fragments that had the lowest utilization were from the MO treatment with only had 46% T-RF utilization. This was the lowest utilization percentage for all enzymes across all treatments.

Variation in fermentation parameters and cell numbers over 16d

The effect of time on the control fermentors is shown in Figures 1B, 2, and 3. There were no significant changes in the fermentation profile of the control fermentors over time. Methane production averaged 28 mmol/day, pH was 6.0, and ammonia (data not shown) averaged 24.3 mg/100mL over the 16d period. The daily pH values, methane production (Figure 2), and ammonia production were unaffected by time. Total VFA was numerically greater on d16, but averaged 55.7 mM over the experiment and was not significantly different from d4 or d10. Neither total nor individual (data not shown) VFA mM concentrations differed, and the A:P remained constant at 3.8 throughout the trial (Figure 3). Total cell counts are shown in Figure 1. The total cell number for the inoculant was always higher than those for the culture contents (data not shown). The cell numbers in the control fermentors averaged 1.35 E9 and did not change significantly over time (Figure 1B).

**Control Fermentors**

As expected, the fermentation was very stable in the control fermentors over time. There were no significant changes in methane production, pH, or ammonia concentration. Also unaffected were total and individual VFA as well as A:P. Cell numbers of the inoculum were greater than the cell numbers of the samples from the fermentor. The cell numbers in the control fermentors did not change significantly over time. One objective of this study was to monitor any changes in microbial populations in control fermentors in order to better characterize shifts in treatment fermentors. The number of unique species in the controls seemed to drop between d10 and d16, which could indicate a change in diversity over time. Because the diversity seemed to change, but the total cell number did not, changes in microbial populations must be due to changes in the number of unique species rather than changes in the number of organisms per species. The total unique species as well as the species in the Multiple and Unclassified divisions indicate a change in diversity over time. The biggest change occurred between d10 and d16, suggesting that adaptation to the fermentors had occurred before d4 and that changes in diversity due to the continuous culture environment did not happen until after d10. Coupled with the cell counts, this shows that the decrease in diversity over time in the control fermentors is because of a decrease in unique species and not in organism number. This also shows that the cultures do not cause the loss of microorganisms over time. It could mean that specific species of organisms become more acclimated to the in vitro environment over time. Also, because
this study was not replicated in vivo, it cannot be ruled out that changes in diversity over time are not also a natural occurrence in the rumen.

Based on the changing fragment lengths of the control fermentors, there was apparently a natural shifting of archaeal populations over time in continuous culture. However, as with the bacterial population data, the similarities between Cd4 and Cd10 indicate that adaptation to the in vitro system occurred by if not before the fourth day, and that any shifting in the population did not occur until after the tenth day. Also, because methane production did not change over time in the control fermentors, but it appears there were fluctuations in the archaeal population, there seem to be several methanogens active in producing methane in the rumen.

As a whole, the fermentation and microbial populations of the control fermentors appeared to be stable over time.

Additive Effects

The fermentation characteristics of the treated fermentors were expected, as M decreased A:P, decreased acetate, increased propionate, and decreased methane and O caused similar results. The similar but less drastic effects of B were also expected. Finally, the lack of significant changes in fermentation due to sequence was also expected. Workers have found that the combination of antibiotics and fat do not seem to have additive effects on fermentation. When B affected fermentation, it was similar to M and O, but the T-RFLP data shows B to have many different effects on the microbial population than the M and O additives. This may be explained by the different mode of action of B. Therefore, the T-RFLP differences between M and O may also be because the additives have different mode of actions.

The fragment lengths that were produced by Rsal digestion that were the same in C over time were also present after additive treatment, suggesting their importance in the rumen and presence even during treatment with M, B, or C. The consistency of these fragments across treatments also suggests that M does not inhibit archaeal methanogens, which supports earlier theories. There are, however, several fragments only detected in the B and O treatments. This could be due to inhibition by M or selection by B and O. The fragment size of 203 bp was present after Rsal digestion in C and B, and O had a fragment size of 204 bp, but there was not one of similar size in M. Therefore, M may have an inhibitory affect on the methanogen with this terminal restriction fragment generated after Rsal digestion. Although methane production was lowered upon treatment with all additives (M, B, and O), there were several archaeal fragment patterns across treatments, suggesting that many methanogens remained active.

Sequence Effects

The sequence in which the additives were added did not alter fermentation or microbial cell numbers. However, there appear to be fluctuations in the microbial population due to sequence. The addition of O to M treated fermentors (MO) resulted in lower diversity than the addition of M to the O treatment (OM), but, the MO treatment also had lower fragment utilization. Therefore, MO could result in lower diversity or could increase the number of unique species that have not been studied and sequenced.

Concluding Remarks

There were no significant effects of time on fermentation of the C fermentors. The first hypothesis holds, as the effects of M and O on rumen fermentation were similar. Based on information obtained at the Class level, the additives M, B, and O caused
population shifts that were different from one another. This is likely due to the different mode of actions of the three additives. It is known that although M and B have similar effects on fermentation, they have different modes of action. Therefore, even though M and O also have similar effects on fermentation, they likely have different modes of action. When studying the mode of action of a supplement in the rumen, it seems to be necessary to look at more than just fermentation parameters.

The second part of the hypothesis holds, as the sequence of adding O and an antibiotic did not affect fermentation, but the sequence did appear to change the microbial population. M dropped fragment utilization, but not if O had already been added. O did not have this affect alone, but it seems to accentuate the affect of M on fragment utilization. The differences in the sequence of M and O addition are likely because of different modes of action of the two additives. When O was added first (OM and OB), there was greater diversity than when the antibiotics were added first (MO and BO).

Roughly half of the unique species in the samples across all treatments are from Unclassified microorganisms and one quarter may belong to closely related species. This shows, along with previous clone library studies, that many of the organisms in the rumen are uncultured.
Table 1. Trial schedule.

<table>
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<th>Fermentor</th>
<th>Days 1-4</th>
<th>Days 5-10</th>
<th>Days 11-16</th>
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</tr>
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<tr>
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<td>B</td>
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</tr>
<tr>
<td>5</td>
<td>C</td>
<td>O</td>
<td>OB</td>
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Table 2. Usage by InSilico of fragments generated by T-RFLP.

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<th>Mspl</th>
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<td>C d4</td>
<td>84</td>
<td>90</td>
<td>98</td>
</tr>
<tr>
<td>C d10</td>
<td>78</td>
<td>96</td>
<td>89</td>
</tr>
<tr>
<td>C d16</td>
<td>87</td>
<td>93</td>
<td>89</td>
</tr>
<tr>
<td>M</td>
<td>79</td>
<td>79**</td>
<td>90</td>
</tr>
<tr>
<td>B</td>
<td>87</td>
<td>92</td>
<td>98</td>
</tr>
<tr>
<td>O</td>
<td>95</td>
<td>95</td>
<td>87</td>
</tr>
<tr>
<td>MO</td>
<td>46**</td>
<td>85</td>
<td>69**</td>
</tr>
<tr>
<td>BO</td>
<td>75</td>
<td>100</td>
<td>86</td>
</tr>
<tr>
<td>OM</td>
<td>90</td>
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<tr>
<td>OB</td>
<td>92</td>
<td>87</td>
<td>93</td>
</tr>
</tbody>
</table>
Table 3. Comparison of T-RFLP from control (A), additive (B), and sequence (C) treatments within the first replicate. Samples were amplified with a bacterial universal primer and digested with Rsal, Hhal, and MspI.

A.

<table>
<thead>
<tr>
<th>Fermentor Sample</th>
<th>Rsal</th>
<th>Hhal</th>
<th>MspI</th>
</tr>
</thead>
<tbody>
<tr>
<td>C d4</td>
<td>21</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>C d10</td>
<td>12</td>
<td>16</td>
<td>28</td>
</tr>
<tr>
<td>C d16</td>
<td>8</td>
<td>11</td>
<td>23</td>
</tr>
<tr>
<td>Fragments in all samples</td>
<td>6</td>
<td>9</td>
<td>17</td>
</tr>
<tr>
<td>Fragments in both C d4 and C d10</td>
<td>10</td>
<td>15</td>
<td>21</td>
</tr>
<tr>
<td>Fragments in both C d10 and C d16</td>
<td>8</td>
<td>9</td>
<td>20</td>
</tr>
<tr>
<td>Fragments in both C d4 and C d16</td>
<td>8</td>
<td>10</td>
<td>18</td>
</tr>
</tbody>
</table>

B.

<table>
<thead>
<tr>
<th>Fermentor Sample</th>
<th>Rsal</th>
<th>Hhal</th>
<th>MspI</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>21</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>M</td>
<td>18</td>
<td>20</td>
<td>16</td>
</tr>
<tr>
<td>B</td>
<td>14</td>
<td>23</td>
<td>25</td>
</tr>
<tr>
<td>O</td>
<td>9</td>
<td>17</td>
<td>31</td>
</tr>
<tr>
<td>Fragments in both C and M</td>
<td>13</td>
<td>15</td>
<td>11</td>
</tr>
<tr>
<td>Fragments in both C and B</td>
<td>13</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>Fragments in both C and O</td>
<td>9</td>
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<td>20</td>
</tr>
<tr>
<td>Fragments in both M and B</td>
<td>9</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>Fragments in both M and O</td>
<td>8</td>
<td>11</td>
<td>15</td>
</tr>
<tr>
<td>Fragments in both B and O</td>
<td>9</td>
<td>14</td>
<td>22</td>
</tr>
</tbody>
</table>

C.

<table>
<thead>
<tr>
<th>Fermentor Sample</th>
<th>Rsal</th>
<th>Hhal</th>
<th>MspI</th>
</tr>
</thead>
<tbody>
<tr>
<td>MO</td>
<td>28</td>
<td>12</td>
<td>19</td>
</tr>
<tr>
<td>OM</td>
<td>9</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>BO</td>
<td>26</td>
<td>11</td>
<td>23</td>
</tr>
<tr>
<td>OB</td>
<td>12</td>
<td>22</td>
<td>25</td>
</tr>
<tr>
<td>Fragments in both MO and OM</td>
<td>8</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>Fragments in both BO and OB</td>
<td>8</td>
<td>9</td>
<td>20</td>
</tr>
</tbody>
</table>
Figure 1. Cell counts of treatment (A) and control (B) fermentors.

A.

B.
Figure 2. Effect of time on the methane production (A) and pH (B) of the control fermentors.

A. 

B.
Figure 3. Effect of time on total VFA production (A) and A:P (B) of the control fermentors.

A.

Total VFA

<table>
<thead>
<tr>
<th></th>
<th>C d4</th>
<th>C d10</th>
<th>C d16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total VF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B.

A:P

<table>
<thead>
<tr>
<th></th>
<th>C d4</th>
<th>C d10</th>
<th>C d16</th>
</tr>
</thead>
<tbody>
<tr>
<td>A:P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 4. Graphical representation of the number of unique species identified per class of control and treatments.
**Figure 4.** The unique fragment patterns of all treatments associated with “rumen” by number (A) and percentage (B) of total unique fragment patterns. The Unclassified species are unique fragments assigned only to Uncultured and Unidentified Rumen Bacterium. The Multiple category includes fragment patterns that may belong to either an unclassified rumen bacterium, a sequenced bacterium, or both.

A.

**Fragment Pattern Breakdown for ”rumen”**

B.

**Fragment Pattern Breakdown of ”rumen”**
Enrichment of Milk with Long-Chain Polyunsaturated Fatty Acids
Ms. Meredith Johnson, Dr. Vivek Fellner and Dr. Jack Odle, NCSU

INTRODUCTION

Much research has been aimed at improving the fatty acid profile of milk so that the proportion of saturated fat is decreased and that of unsaturated fatty acids is increased (Jenkins and McGuire, 2006). Recent efforts have focused on increasing the concentration of LC-PUFA, particularly that of omega-3 (n-3) FA, in milk. These fatty acids have been shown to enhance infant growth and visual and cognitive development and reduce the risk of cardiovascular disease, autoimmune disorders, type 2 diabetes, hypertension, rheumatoid arthritis, and certain cancers (Connor, 2000, Simopoulos, 1999). In spite of these health benefits, intake of n-3 fatty acids from typical diets is usually low and the n-6 intake is high. This raises the n-6 to n-3 ratio to about 20-30:1, up from the healthier 1-4:1 (Simopoulos, 1999).

Besides egg yolk, chicken, and oily fish, human milk and supplemented food are the only foods in the typical US diet that are a good source of DHA. As of 2004, no infant formula or baby foods in the United States contained fish (Hoffman, et al., 2004). Mothers are discouraged from eating too much fish because of the risk of metal contamination and, like children, may consume very little or no fish (Oken, et al., 2003). This makes it imperative to provide sources of n-3 PUFA apart from fish or fish oil supplements. Because of the already beneficial effects of consuming dairy for mothers and children, enrichment of milk with healthful fatty acids would help provide a portion of the recommended daily LC-PUFA allowance.

Numerous factors affect the fate of unsaturated fatty acids in the rumen, and the most extensively studied are those that affect microbial activity or biohydrogenation (Jenkins, 1993). Extensive biohydrogenation of unsaturated fatty acids in the rumen is implicated as a major process that determines the profile of fatty acids supplied to the mammary gland. Thus, strategies to enhance milk fat LC-PUFA would involve increasing rumen outflow of these fatty acids and their subsequent incorporation into milk fat.

Numerous groups have attempted to use fish oil to increase LC-PUFA in the milk (AbuGhazaleh, et al., 2002, Donovan, et al., 2000, Lock and Bauman, 2004, Palmquist and Grinari, 2006). Several studies have incubated rumen fluid with fish oil or pure LC-PUFA to investigate their fate in the rumen, including their possible effects on and involvement in biohydrogenation (AbuGhazaleh and Jenkins, 2004a, AbuGhazaleh and Jenkins, 2004b, Dohme, 2003, Gulati, et al., 1999). These experiments have shown that both the oil concentration in the fluid and the fatty acid concentration in the oil influence fatty acid metabolism (AbuGhazaleh and Jenkins, 2004a)

The objective of this study was to determine the level of protection of algal oil either intact or extracted from biohydrogenation by ruminal microbes.

MATERIALS AND METHODS

The fatty acid compositions of the diets are shown in Table 1. Alfalfa hay used in this experiment consisted of pellets and was purchased from a local feed store. The intact algal oil (diet I), extracted algal oil (diet E), and fat free biomass were all provided by Martek Biosciences. Diets were mixed with a Blakeslee Food Cutter (Model FC19; Ann Arbor,
Michigan). For all diets, corn silage was mixed first, followed by the cottonseed hulls, and then the concentrate mix. The control diet (C) received no other ingredients. For the I diet, the intact algal oil was added next, and for the E diet, the fat free biomass and then the extracted algal oil were added. Each ingredient was mixed for one minute.

Rumen contents were obtained from a fistulated non-lactating Holstein cow fed a forage diet. Rumen contents were filtered through double-layered cheesecloth and mixed with previously prepared artificial saliva. Before the addition of rumen fluid and buffer mixture, the in vitro bottles were purged with CO2 to displace any oxygen. Then 30 mL of the fluid and buffer mixture were added and the bottles were again purged with CO2, capped, and placed in a water bath preheated to 39°C.

Sixteen bottles were used per treatment. One served as a negative control, as it only contained 30mL of the rumen fluid and buffer mixture. The other 15 bottles were split into 3 treatment groups, and each treatment received 0.5g (DM basis) of the C, E, or I diet. One bottle from each treatment served as a positive control and was sealed and chilled at 0h. One bottle from each treatment was collected at 2, 4, 6, and 24 hr after inoculation. The experiment was replicated 3 times.

At 0, 2, 4, 6, and 24 hours, one bottle from each treatment was removed from the water bath, the cap was sealed, and the bottle was cooled to 4°C. The entire contents of each bottle were extracted using the Bligh and Dyer method (1959) with some modifications. The extractions were then methylated by the procedure outlined by Kramer (1997) and analyzed by gas liquid chromatography (model CP-3380; Varian; Walnut Creek, CA).

All data were analyzed using the Proc Mixed procedure of SAS. The random variable was rep. Orthogonal Contrasts were applied between the Control and Algal Oil samples and between the Extract and Intact samples. Significance is reported at p < 0.05.

RESULTS AND DISCUSSION

The proportions of the individual fatty acids in each treatment in the batch culture are presented in Table 2. The amount of C16:0, EPA, DPA, DHA, and the Others were all greater in E and I than C (p<0.01). Both cis, trans C18:2 and AA were highest in I, followed by E, and lowest in C (p<0.05). C18:0 was highest in C, followed by E, and lowest in I (p<0.05). C18:2 trans-10, cis-12 remained higher in C than E or I (p<0.05). For the first time, there were differences in trans-C18:1 and cis-C18:1, as they were both higher in I and E than C (p<0.01 and p<0.05, respectively). The remaining fatty acids, C18:2 and C18:2 cis-9, trans-11, did not differ across treatments.

The quantities of the fatty acids following 24 h of incubation indicate that little biohydrogenation of the very LC-PUFA is occurring. Also, the conversion of C18:2 is not blocked by the presence of A, as the amount of the fatty acid did not differ. However, A does seem to block complete biohydrogenation to C18:0, as this step only occurs in C. The presence of the very LC-PUFA in A may be altering the biohydrogenation pathways. Alternatively, although little biohydrogenation of the very LC-PUFA is occurring, there may be formation of a potent isomer of DHA or of another LC-PUFA that might affect C18 fatty acids even at low amounts. The increases in cis-C18:1 and trans-C18:1 observed is consistent with earlier studies (AbuGhazaleh and Jenkins, 2004b). It has been hypothesized that the increase in cis-11 C18:1 may be from chain elongation of C16:1 and the increase in trans-11 C18:1 could be from inhibition of hydrogenation to C18:0
(Palmquist and Grinari, 2006). Other theories on changes in lipid metabolism include the partial oxidation or hydrogenation of C20 and C22 fatty acids to C18 fatty acids (Donovan, et al., 2000) or the lack of specific isomerase and reductase enzymes for these very LC-PUFA (AbuGhazaleh and Jenkins, 2004b).

The fate of both DHA and EPA in batch cultures of rumen fluid have been investigated using pure forms of the fatty acids (AbuGhazaleh and Jenkins, 2004a). Several concentrations of DHA (0, 5, 10, 15, and 20 mg) and EPA (0, 5, 10, and 15 mg) were tested to determine the effect of level of fatty acid on biohydrogenation of DHA and EPA. The amount of DHA and EPA in the cultures decreased over time, with the disappearance and the concentration of the added fatty acids exhibiting an inverse relationship. This can be used for comparison with the present study, as the E cultures were incubated with 15.5 mg DHA and the I cultures were incubated with 18.9 mg DHA, and a similar level of DHA biohydrogenation was observed.

It has been suggested that DHA and EPA could have been biohydrogenated, their carbon chain could have been shortened, or they could have been transformed into other C22:6 and C20:5 isomers, respectively (AbuGhazaleh and Jenkins, 2004a). Increases in unsaturated fatty acids, particularly C18:1, with addition of DHA and EPA raise the possibility that DHA and EPA could have influenced the unsaturated fatty acid concentration whether directly, via shortening of their carbon chain, or indirectly, by inhibiting the activity of the enzyme reductase of ruminal microorganisms (AbuGhazaleh and Jenkins, 2004a).

**Concluding remarks**

Algal oil altered the fermentation profile of continuous cultures by increasing propionate and decreasing A:P as well as methane production (data not shown). Changes in these parameters, as well as an increase in pH, indicate shifts in the microbial population in response to supplemental algal oil.

There appeared to be limited biohydrogenation of LC-PUFA, particularly DHA. Because the supplement was high in DHA, the high concentration of the fatty acid likely protected it from biohydrogenation. Because the fatty acid profile of both E and I were similar, it seems that the concentration of the fatty acid, rather than the presence of a protective substance, may be the most important factor in predicting the extent of biohydrogenation.

Not only did the biohydrogenation of DHA and other LC-PUFA appear inhibited by the algal oil in either its intact or extracted form, but the presence of the LC-PUFA appeared to alter the biohydrogenation of fatty acids 18 carbons in length. The batch culture showed C18:2 to be present in the same amount in all treatments after 24hr, but the absolute amount (mg) of C18:1 was greater in E and I compared to C; C18:0 was, however, greater in C compared to E and I. Given the lesser formation of 18:0 in E and I, it seems both those treatments inhibited biohydrogenation compared to C. The accumulation of 18:1 cis and trans isomers with E and I suggest inhibition at the terminal step leading to 18:0 formation.
### Table 1. Fatty acid composition (% of total fatty acids) of the diets.

<table>
<thead>
<tr>
<th>Fatty Acid</th>
<th>Control</th>
<th>Intact (I)</th>
<th>Extract (E)</th>
<th>Fat Free Biomass</th>
</tr>
</thead>
<tbody>
<tr>
<td>C12</td>
<td>0.17</td>
<td>0.37</td>
<td>0.45</td>
<td>0.47</td>
</tr>
<tr>
<td>C14</td>
<td>0.34</td>
<td>10.01</td>
<td>11.00</td>
<td>13.16</td>
</tr>
<tr>
<td>i-15</td>
<td>0.00</td>
<td>0.01</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>C15</td>
<td>0.00</td>
<td>0.36</td>
<td>0.35</td>
<td>0.42</td>
</tr>
<tr>
<td>i-16</td>
<td>0.00</td>
<td>0.08</td>
<td>0.08</td>
<td>0.00</td>
</tr>
<tr>
<td>C16</td>
<td>20.34</td>
<td>26.19</td>
<td>28.41</td>
<td>28.92</td>
</tr>
<tr>
<td>C17</td>
<td>0.00</td>
<td>0.07</td>
<td>0.08</td>
<td>0.00</td>
</tr>
<tr>
<td>C18</td>
<td>3.14</td>
<td>0.93</td>
<td>1.08</td>
<td>0.91</td>
</tr>
<tr>
<td>C18:1 trans</td>
<td>0.77</td>
<td>0.10</td>
<td>0.09</td>
<td>0.69</td>
</tr>
<tr>
<td>C18:1 cis</td>
<td>20.52</td>
<td>3.70</td>
<td>4.71</td>
<td>0.54</td>
</tr>
<tr>
<td>cis-trans</td>
<td>0.00</td>
<td>0.12</td>
<td>0.14</td>
<td>0.06</td>
</tr>
<tr>
<td>C18:2</td>
<td>50.33</td>
<td>8.44</td>
<td>8.32</td>
<td>0.50</td>
</tr>
<tr>
<td>C20</td>
<td>0.41</td>
<td>0.14</td>
<td>0.14</td>
<td>0.00</td>
</tr>
<tr>
<td>C18:3n-3</td>
<td>3.54</td>
<td>0.66</td>
<td>0.76</td>
<td>0.04</td>
</tr>
<tr>
<td>AA (ARA)</td>
<td>0.00</td>
<td>0.66</td>
<td>0.52</td>
<td>0.50</td>
</tr>
<tr>
<td>EPA</td>
<td>0.00</td>
<td>1.77</td>
<td>1.49</td>
<td>1.88</td>
</tr>
<tr>
<td>DPA</td>
<td>0.00</td>
<td>11.03</td>
<td>10.89</td>
<td>13.22</td>
</tr>
<tr>
<td>DHA</td>
<td>0.00</td>
<td>26.96</td>
<td>27.36</td>
<td>35.27</td>
</tr>
<tr>
<td>Others</td>
<td>0.46</td>
<td>8.40</td>
<td>4.13</td>
<td>3.41</td>
</tr>
</tbody>
</table>

### Table 2. Concentration (mg) of LCFA at 24hr.

<table>
<thead>
<tr>
<th>Fatty Acid</th>
<th>Control (C)</th>
<th>Extract (E)</th>
<th>Intact (I)</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>C16:0</td>
<td>15.5d</td>
<td>23.9e</td>
<td>24.1e</td>
<td>1.33</td>
</tr>
<tr>
<td>C18:0</td>
<td>22.5d</td>
<td>5.5e</td>
<td>4.8e</td>
<td>1.33</td>
</tr>
<tr>
<td>C18:1 trans</td>
<td>7.8d</td>
<td>5.7e</td>
<td>5.5e</td>
<td>0.25</td>
</tr>
<tr>
<td>C18:1 cis</td>
<td>6.7d</td>
<td>4.2e</td>
<td>3.7e</td>
<td>0.39</td>
</tr>
<tr>
<td>cis,trans</td>
<td>0.3a</td>
<td>0.4b</td>
<td>0.4b</td>
<td>0.03</td>
</tr>
<tr>
<td>C18:2</td>
<td>8.3d</td>
<td>3.5e</td>
<td>3.9e</td>
<td>0.90</td>
</tr>
<tr>
<td>C18:2 c-9, t-11</td>
<td>0.3</td>
<td>0.2</td>
<td>0.2</td>
<td>0.09</td>
</tr>
<tr>
<td>C18:2 t-10, c-12</td>
<td>0.1</td>
<td>0.0</td>
<td>0.0</td>
<td>0.03</td>
</tr>
<tr>
<td>AA</td>
<td>0.0d</td>
<td>0.4e</td>
<td>0.5f</td>
<td>0.03</td>
</tr>
<tr>
<td>EPA</td>
<td>0.0d</td>
<td>0.8e</td>
<td>1.0e</td>
<td>0.08</td>
</tr>
<tr>
<td>DPA</td>
<td>0.0d</td>
<td>8.3e</td>
<td>7.9e</td>
<td>0.63</td>
</tr>
<tr>
<td>DHA</td>
<td>0.0</td>
<td>18.0</td>
<td>18.2</td>
<td>1.10</td>
</tr>
<tr>
<td>Others</td>
<td>4.3</td>
<td>5.4</td>
<td>4.5</td>
<td>0.56</td>
</tr>
</tbody>
</table>
UNDERGRADUATE EDUCATIONAL OPPORTUNITIES In ANIMAL SCIENCE at NORTH CAROLINA STATE UNIVERSITY

Dr. Jeannette A. Moore, Undergraduate Teaching Coordinator

see also: http://www.cals.ncsu.edu/an_sci/home/teaching.htm

Baccalaureate Program
Students who choose Animal Science as a major have two tracks to choose from, Science or Industry. Both result in a Bachelor of Science (B.S.) in Animal Science. The science track is designed for students who are interested in graduate school, vet school, medical school, or other careers that require a strong science background. The industry track, which requires fewer courses in physics and chemistry and more courses in business and production, prepares students for careers in production animal agriculture and related fields. Students who maintain a Grade Point Average of 3.35 or higher (on a 4.0 scale) may participate in the Honors Program, which involves completion of honors courses and an honors Research or Teaching project.

Associate Degree Program
Students who are interested in a two-year Associate of Applied Science (A.A.S.) degree may major in Livestock/Poultry Management (LPD) through the Agricultural Institute, which is part of the College of Agriculture and Life Sciences at North Carolina State University. This program provides many hands-on, practical experiences that give graduates excellent skills for employment in animal-related industries; however, courses will not transfer to a baccalaureate program. For more information, call (919) 515-3248, send e-mail to Ag_Institute@ncsu.edu, or look on the web at: http://www.cals.ncsu.edu/agi/

Pre-Vet Students
Many pre-vet students choose Animal Science as their major, but other options are available. Pre-vet is not a major, but is a course of study within the chosen major. Majors in the College of Agriculture and Life Sciences that work well for students planning to continue on to a College of Veterinary Medicine include (but are not limited to): Animal Science, Biochemistry, Biology, Microbiology, Poultry Science, and Zoology. A minor in Animal Science is available for students who choose a major other than Animal Science.

Animal Experience
Students pursuing either a B.S. degree in Animal Science or an A.A.S. degree in Livestock/Poultry Management have the opportunity to learn hands-on animal agriculture in classes and labs that are taught at our Animal Educational Units (swine, dairy, beef, horse, sheep/goat, and poultry). Many students also obtain part-time jobs at the animal units, and some of the educational units have apartments where live-in students gain valuable experience throughout the semester or summer.

Clubs
All students (B.S. and A.A.S. candidates) have the opportunity to participate in the many clubs on campus. The Animal Science Club, Collegiate Horseman's Association, Dairy Science Club, and Rodeo Club are all popular with Animal Science and Livestock majors. Many of our students are also members of the Companion Animal Club and the Pre-Veterinary Medical Association. In addition to the clubs mentioned above, there is an N.C. State University Equestrian Club and Team (sponsored by Intramural Sports). Students gain valuable experience with animals in these clubs, but also learn important communication skills when they take on new responsibilities as project leaders or club officers.

Updated January 2007
**Internships and Other Opportunities**

Animal Science and Livestock students are encouraged to complete Summer Internships working on a farm, at a veterinarian's office, or in another animal-related field. Students may earn up to 3 credit hours of Free Electives for participating in such an internship. In addition, baccalaureate students may gain valuable experience and up to 3 credit hours for being Teaching Assistants for Animal Science courses, or for participating in Undergraduate Research.

Animal Science and Livestock students also have the opportunity to compete inter-collegiately as members of the Livestock, Horse, or Dairy judging teams.

**Careers in Animal Science**

A baccalaureate degree in Animal Science provides graduates with knowledge and experience in Nutrition, Anatomy and Physiology, Reproduction, Genetics, and Management of animals. In addition, courses in Communications, Humanities, Social Sciences, and other areas provide students with a broad background to prepare them for a variety of careers.

Many of our baccalaureate graduates continue their education at a College of Veterinary Medicine, which requires an additional four years of study beyond the Bachelor's degree. Other graduates choose jobs in related fields, such as becoming Research Technicians in laboratories, entering the sales or marketing force for pharmaceutical companies, or continuing their education for a Master's or Doctoral Degree.

Graduates may also choose occupations such as Farm Manager (swine, cattle, or horse farms), Extension Agent (Livestock or 4-H Agents with the Cooperative Extension Service), Kennel Manager, or High School Teacher (the teaching certificate must be earned). They may choose jobs in Livestock Sales, Marketing, or Reporting, or in related fields. Some graduates enter business (their own or as managers), banking (such as Farm Credit), or choose to work for Breed Associations.

Other career opportunities for graduates from our baccalaureate program include working in offices for veterinarians, in retail stores (co-ops, tack stores, pet stores, agricultural supply stores), in service-related fields (such as agricultural consulting), as trainers (horses or dogs), or as writers for animal-related publications.

Graduates from the Associate Degree program are highly qualified for jobs as farm managers, agricultural store managers or sales personnel, and other related careers.

**Visiting Campus**

Prospective students (Juniors or Seniors in High School, or transfer students) who are interested in visiting the N.C. State University campus to learn more about opportunities in the College of Agriculture and Life Sciences are encouraged to participate in the Spend-A-Day-At-State Program. See: http://harvest.cals.ncsu.edu/index.cfm?showpage=37 or call 919-515-3248.

**More Information on Animal Science**

To request specific information about Animal Science baccalaureate degree programs, please contact the Animal Science Undergraduate Teaching Coordinator's office:

- Dr. Jeannette A. Moore
- 117 Polk Hall, Box 7621
- Raleigh, NC 27695-7621.
- phone = 919-515-3028
- e-mail = Jeannette_Moore@ncsu.edu

More information about the Department of Animal Science at North Carolina State University may also be found at the web address listed at the top of this handout.

More information on the Associate of Applied Science (2-year) degree can be found at: [http://www.cals.ncsu.edu/agi/](http://www.cals.ncsu.edu/agi/)

Information on other departments, as well as our College of Veterinary Medicine and the Agricultural Institute, can also be found at the N.C. State University web site. See: [http://www.ncsu.edu/](http://www.ncsu.edu/)
Milking and Mastitis Management Articles for 2007

Dr. Donald E. Pritchard, Adjunct Professor and Extension Dairy Specialist
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During 2007 I wrote several articles about various milking management and mastitis management topics. I have compiled them in the following article for people to read who perhaps did not see them previously, or to read again. I hope they will assist people do a better job of managing the aspects of their dairy operations that have been addressed in the articles.

Review Your Mastitis Control Program

Several years ago the NMC (National Mastitis Council) developed a list of 10 steps to follow in a mastitis control program. That list was recently updated. As we start a new year, I believe it would be good for all dairy producers to review the list and compare their program with what mastitis researchers and educators are suggesting. The edited list follows. For a complete listing of the recommendations go the NMC website and look under the “Information and Resources” section (http://www.nmconline.org/).

1) **Establish Goals for Udder Health** – set realistic targets for average herd SCC and clinical mastitis rate – review your goals on a timely basis and prioritize management changes to achieve your goals

2) **Maintain a Clean, Dry, Comfortable Environment** – stall size, bedding management, housing and traffic area cleanliness, ventilation system, stocking density, environmental influences (heat stress, stray voltage, etc.), and keeping cows standing after milking are topics to consider under this category

3) **Follow Proper Milking Procedures** – examine foremilk for mastitis, apply pre-milking teat disinfectant, dry teats properly, wear clean gloves, attach teat cups squarely and level with the udder, adjust cluster during milking as needed, avoid machine stripping, apply teat disinfectant after teat cup removal, use teat dips that have been proven effective, teat dips are preferred to sprays, and milk cows infected with contagious mastitis last are topics to include in your program

4) **Maintain and Use Milking Equipment Properly** – install or upgrade equipment to standards, service and maintain equipment according to guidelines, replace wearable parts on a schedule as recommended or sooner if broken, sanitize equipment properly

5) **Keep Good Records** – keep thorough records of udder health treatments, use computerized or manual records of subclinical mastitis information (SCC data)

6) **Manage Clinical Mastitis During Lactation Appropriately** – establish a Herd Udder Health Advisory Team and then develop and follow a protocol for handling clinical mastitis cases (treatment methods, costs, drugs to use, etc, should be part of the plan the advisory team develops)

7) **Establish an Effective Dry Cow Management Program** – proper nutrition, dry treatment procedures, facility and environment management for maximum health
benefits, the use of appropriate vaccinations, and cow cleanliness are points to include in an effective program

8) **Follow a Biosecurity Program Against Contagious Pathogens** – check cows for mastitis before purchase and then isolate purchased animals, market or segregate cows that are persistently infected, check udder health status of first-calf heifers as this can have an effect on the herd’s status

9) **Monitor Udder Health Status Regularly** – use SCC information (either from a lab or cow-side test) to regularly monitor individual cow, group, and total herd udder health data, use the data to evaluate protocols, compare herd data with average data from regulatory or milk marketing organization

10) **Periodically Review Your Mastitis Control Program** – have your Herd Udder Health Advisory Team meet at regularly scheduled intervals to review the udder health status of your herd, and to adjust your mastitis control program as needed

Comparing your mastitis management programs and procedures with those in the recommended list from the NMC, and then changing or improving your program as needed can lead to improved udder health, more milk and more profit from your herd. Don’t delay in talking with a knowledgeable advisor who can help you establish a Herd Udder Health Advisory Team for your herd.

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**Are Your Herd’s SCCs Improving?**

What are the monthly and yearly trends in your herd’s somatic cell counts? As a producer, do you take the time to look at the data and strategize on how your management practices could be improved so the SCCs continue to decrease over time? I believe all dairy producers should be giving adequate attention to the SCC data they receive, and continually strive to produce higher quality milk.

It is an accepted fact that herd SCC values vary by region of the country. The weather conditions in the southeast/southern states make it more challenging to produce milk with a consistently low SCC than in most other regions of the country. And still, there are many herds in the southeast region that consistently produce milk of very high quality. There are herds in every southeast region state that produce very high quality milk with low SCCs. Here in North Carolina there are herds, both small and large (1,000+ cows), which have been producing milk with a SCC of under 200,000 as a yearly average for many years. For the last twelve years the North Carolina Dairy Producers Association has sponsored a quality milk producer award program which each year recognizes the top quality milk producing herds in the state. The award recipients have consistently had yearly herd SCC averages in the low 100,000s. For 2006 the top nine recipients (three in each of three herd size categories) all had yearly SCC averages between 107,000 and 172,000. Not bad for herds in a state that each year receives many months of humid and hot weather.

So, if some herds in the “challenging” southeast region can produce milk with very low SCCs, what do other dairy producers need to do to also be able to produce very high
quality milk. I suggest that the basics of producing high quality milk need to be followed religiously. In a previous article I discussed those basic practices which have been established by the National Mastitis Council. I repeat them here for your review.

11) Establish Goals for the Udder Health Of Your Herd
12) Maintain a Clean, Dry, Comfortable Environment For Cows and Heifers
13) Follow Proper Milking Procedures
14) Maintain and Use Milking Equipment Properly
15) Keep Good Udder Health Treatment Records
16) Manage Clinical Mastitis During Lactation Appropriately for the Type of Mastitis
17) Establish an Effective Dry Cow Management Program
18) Follow a Biosecurity Program Against Contagious Pathogens
19) Monitor Udder Health Status Regularly
20) Periodically Review Your Mastitis Control Program With Competent Advisors

I believe that nearly all dairy producers can produce higher quality milk if they give adequate attention to the practices required to do so. Producers should establish a Herd Udder Health Advisory Team, and then implement the recommended programs that will lead to lower somatic cell counts, higher quality milk, improved udder health, more milk and more profit from your herd.

### Improving Udder Health Through Sire Selection

At the 2007 annual meeting of the NMC (National Mastitis Council), Dr. George Shook from the University of Wisconsin presented information on the long-term impact of sire selection on udder health of cows. He contends that dairy producers and the professionals who advise them on the sires to use in a herd’s breeding program should give more consideration to genetic evaluation data for somatic cell scores. While looking at short-term management issues is important when dealing with milk quality problems, the genetic evaluation data on the somatic cell scores of the daughters of bulls should also be considered because of the resulting long-term impact on the quality of milk produced by a herd. A summary of Dr. Shook’s recommendations as presented in his paper published in the 2007 NMC annual meeting proceedings is given below.

Recommendation 1. Include sire selection on the checklist when considering how to manage mastitis in a herd and improve the quality of milk produced. Even when certain popular bulls have desirable economic traits, use them sparingly if their PTA-SCS (predicted transmitting ability – somatic cell scores) are 3.3 or higher (equivalent to about 125,000 somatic cells /ml or higher). While sire selection will not solve a mastitis problem immediately, it should be part of a herd’s long-term mastitis management program, even in herds with excellent udder health management.

Recommendation 2. Use a selection index as an initial screening for selecting AI bulls. This
will provide a moderate amount of selection emphasis on PTA-SCS. Create a long list of candidate bulls using the selection index chosen, such as lifetime net merit (LNM) or type-production index (TPI).

Recommendation 3. When creating a short list of service sires to use from the long list, include PTA-SCS among the criteria to use but do not overemphasize SCS to the exclusion of other economically important traits. Make limited use or avoid altogether the 5-10% of bulls with the highest PTA-SCS.

Recommendation 4. Herds with low somatic cell counts (SCC) should give the same attention to PTA-SCS in sire selection as herds with high average SCC. This practice will promote continued genetic improvement for SCS.

Recommendation 5. Producers who can manage artificial insemination should use AI bulls. Those who can not or choose not to for various reasons should purchase bulls from dams with high selection index values and sired by well-qualified AI bulls.

The above recommendations/guidelines can assist dairy producers and their consultants/advisors make sire selection decisions that will have a long-term effect on improving the udder health and milk quality of a herd. For short-term udder health management strategies to include in your herd’s mastitis management program, contact your veterinarian, milk handler field representative, extension specialist/agent, or other competent consultant.

Animal Welfare – A Priority For Producing Quality Milk

I suspect most dairy producers do not associate animal welfare concerns with producing quality milk. Rather, they would most often think of animal health and productivity as the reasons to give attention to how their cattle are housed, handled and managed (their welfare). At the 46th annual meeting of the NMC (National Mastitis Council), Dr. Jim Reynolds, DVM from the University of California at Davis, gave an interesting presentation about why producers should also associate the production of high quality milk and mastitis control with the welfare of their cattle. A summary of part of his comments that were published in the proceedings of the meeting are presented below. They can serve as a guide for dairy producers and their employees as they operate their dairies and care for their cattle with animal welfare concerns being a priority.

What happens to cows outside the milking parlor can greatly affect the quality of milk they produce and their welfare. How they are handled as they are moved to and from the parlor can influence how well they let-down their milk and milk out, and their feed intake when they return to the housing barn. Hitting, yelling at, and rushing the cows are certainly unacceptable practices. The surfaces of the alleys and holding pen can be a concern for cow safety if they are too smooth and cause cows to slip. Cows that are hurried as they are
moved often slip more and tend to be more nervous, prone to injury, and subsequently may produce less milk. Furthermore, the milk may be of lower quality because the udders get dirty when the cows fall, and may not get cleaned properly before milking.

The housing conditions the cows live in definitely affect their welfare and the quality of milk they produce. Cows require clean, well bedded stalls of the correct design and size to promote clean udders and reduced teat end bacteria exposure. Cows with cleaner udders and teats should have a lower incidence of udder infection and clinical mastitis. And, those cows will be in better health and feel better, which are certainly welfare concerns.

How cows are handled in the parlor can also greatly affect the quality of milk produced. The milking routine practices that are followed and the operation of the milking equipment are major influences on milk quality. Detecting and properly treating udder infections, properly cleaning the teats before milking, obtaining optimum milk let-down, applying and removing the milking units correctly, and using pre and post milking teat dips are important practices for reducing the incidence of mastitis. Since mastitis is usually a painful inflammation, minimizing the incidence of this disease is certainly an animal welfare concern.

Dr. Reynolds concluded his presentation with the recommendation that dairy producers should have their dairy facilities and husbandry management practices audited by an outside, knowledgeable person to verify that the husbandry of the animals conforms to predetermined standards. While most producers will probably not adopt this suggestion currently, I suspect the time is coming sooner than we may think when such an audit and certification that acceptable animal welfare practices are being followed will be required of all dairy producers. Check out your practices now and be ahead of what is to come.

### Average Yearly DHI SCCs Continue to Decline

Each year the USDA Animal Improvement Programs Laboratory generates a report of the somatic cell count (SCC) information for herds enrolled in DHI. The report for 2006 was recently released and shows a continuation of the yearly downward trend in the average SCC data of milk produced by cows in DHI tested herds. During 2006 approximately 57% of the cows in the U.S. were enrolled in DHI. Hopefully the SCC level in milk produced by cows in non-DHI tested herds also declined in 2006. All dairy producers, whether on DHI or not, should always strive to produce higher quality milk.

Shown in the table below is selected information from the report that shows how certain SCC data have changed over the last five years. Included are information for the U.S. and for North Carolina, a state in the more humid and hot region of the country where SCC data are often higher than the national averages.
### Milk Quality and Free Stall Bedding Management

Dairy producers know that keeping free stalls clean and comfortable is an important component of producing quality milk. Dirty cows usually result in low-quality milk. But even with this knowledge, many producers still do not manage their free stalls properly. At the 2007 summer regional meeting of the NMC, Drs. Jeffrey Reneau and Russell Bey from the University of Minnesota discussed the relationship of free stall bedding management and milk quality. Edited excerpts from their paper published in the proceedings of the meetings are reprinted below. Their comments are excellent guidelines for producers to use as they strive to produce high-quality milk.
The choice of bedding material will depend on compatibility with the farm’s manure system, availability, cost, and the characteristics that will best facilitate cow hygiene, comfort and udder health. While clean sand has become the “gold standard” among bedding materials, many other materials, including recycled manure solids, are used successfully. Regardless of the bedding material used, maintaining clean, well bedded stalls is imperative to having clean cows.

The frequency of changing the bedding material will depend on the material used, with organic materials requiring more frequent changing. The goal is to keep the bacteria count in the bedding as low as possible so teat ends and udders are in contact with the lowest number of bacteria possible while the cows are lying in the free stalls. Bedding conditioners can help slow the rate of bacteria growth, but frequent application is required, especially for organic materials.

Bedding management practices are affected by many factors, including the following: cow density (crowding), nutrition level, stall cleaning frequency, stall design, alley scrapping frequency, ventilation, bedding storage method, weather, bedding frequency, and bedding strategies (e.g. no bedding used or piling bedding in front of stalls).

The researchers gave the following five key “take home messages” from their presentation:
1) Bedding bacteria counts are positively related to teat end bacteria counts; teat end bacteria counts are positively correlated with intramammary infections; and there is a positive relationship between cow hygiene and somatic cell counts. 2) To remain healthy and productive, cows need to lie down 11 to 12 hours each day. These long durations of rest place teats in direct contact with bedding material. Therefore, consistent efforts to minimize teat exposure to environmental bacteria through bedding management will be crucial to maintaining udder health and quality milk. 3) Improved cow hygiene will reduce teat exposure to environmental mastitis pathogens, reduce intramammary infections, and reduce SCC. 4) Excellent pre-milking cow prep to remove environmental bacteria from teat surfaces prior to milking is the last line of herd management defense in assuring consistent production of quality milk. 5) Whatever bacteria are not successfully removed during the pre-milking cow prep will end up in the bulk tank milk. Bulk tank or line sampling of each milking shift and culturing for environmental pathogens will accurately indicate the effectiveness of pre-milking cow prep. Improved bedding management can result in higher quality milk, but it requires consistent attention to doing things correctly that leads to cleaner cows when they are milked.

Updated Thoughts On Heifer Mastitis and Its Control

In recent years Dr. Larry Fox from the University of Washington has been one of the leading researchers on heifer mastitis and its control. His collaborative work with others has given dairy producers excellent information on the incidence and possible control methods of this disease. At the 2007 summer regional meetings of the NMC Dr. Fox presented his current thinking about heifer mastitis and its control. His concluding remarks as published in
the proceedings of the meetings are reprinted below. They summarize the current information and guidelines about heifer mastitis management.

“Mastitis in heifers is not the rare event that perhaps was once considered. Intramammary infections (IMIs) by coagulase negative staphylococci are the most prevalent heifer mastitis form. However, infections by coagulase positive staphylococci may cause 5-7% prevalence in heifers, dependent on region. The warmer climates may have the greatest prevalence, and work in Louisiana suggests flies may transmit this disease, and that fly control may be effective in reducing the incidence in heifers. Work at Washington State indicated that prepartum skin colonization of heifers in the inguinal area (groin) was a risk factor for IMIs in heifers at calving. However, no method of control was identified. A second Washington State study determined that herds that import heifer replacements had more strains of *S. aureus*, and a higher prevalence of *S. aureus* IMIs in general, than other herds. Moreover, closed herds appeared to have the least problem with *S. aureus* IMIs. This might suggest that biosecurity might have a role in *S. aureus* mastitis control if carrier animals could be identified. Logically, it would seem that use of antibiotic therapy prepartum, similar to intramammary dry cow therapy for lactating cows, might have a role in control of heifer mastitis. Early work indicated excellent reduction in prevalence of heifer IMIs when such treatment was applied. A first study in one herd demonstrated an economic benefit, as demonstrated by improved milk production and reduced somatic cell count, in heifers that received intramammary antibiotic preterm. A follow up study done in 6 states and one Canadian province in 9 herds did not demonstrate that such therapy would improve milk production in the first lactation, nor improve milk somatic cell counts. However, such therapy in this study did significantly reduce IMIs during lactation. Thus it would appear that the reduction in the IMIs in heifers seen in the multi-site study did not translate to improved production and cell count, thus no improved economic benefit. It should be noted that results from a preliminary study recently conducted in The Netherlands would suggest that success of preterm intramammary antibiotic therapy may be a function of the herd mastitis prevalence; with greater economic success associated with herds with high somatic cell counts. This in turn might suggest that such efficacy might be greater when major pathogens are the predominant mastitis agent in heifers and cures of these agents lead to improved milk production, reduced somatic cell counts and therefore economic benefit.”

While the incidence of heifer mastitis is not a serious problem in many herds, its prevalence is great enough that producers should give more attention to preventive practices. Greater milk production and herd profitability can result from a minimal effort in checking and treating infected heifers as needed preterm.

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**Raw Milk Bacteria Tests – What Do They Indicate?**

Dairy producers know that the quality of milk and dairy products that consumers purchase depends in large part on the quality of milk they produce. While there can be handling problems by processors, distributors, and retailers, the quality of the milk will never be
better than it was when produced at the farm. To monitor the milk quality at the farm, regulatory agencies check periodically for somatic cell and bacteria counts, among other things. In addition, milk marketing cooperatives/handlers also check the milk for various things.

Most producers regularly receive information on the somatic cell count, standard plate bacteria count, and the preliminary incubation bacteria count of the milk they produce. However, many producers do not understand what these tests indicate, especially the bacteria tests. Dr. Steven Murphy from Cornell University described in a paper he wrote a few years ago what these two bacteria tests indicate. His comments are summarized below.

The **Standard Plate Count (SPC)** of raw milk gives an indication of the total number of aerobic bacteria present in the milk at the time of pickup at the farm. Milk samples are plated onto a nutrient media, incubated for 48 hours at 90°F, and then the number of bacteria colonies are counted. The value is reported as number of colony forming units per milliliter of milk. The legal limit of the number that can be in milk is 100,000, but most producers usually have values below 10,000. The most frequent cause of a high SPC is poor cleaning of the milk system (milking units, lines, bulk tank). Another cause frequently found is failing to rapidly cool milk to less than 40°F. Sometimes milking cows with dirty teats, and maintaining unclean milking and housing facilities can be the cause.

The **Preliminary Incubation Count (PIC)** reflects milk production practices. PICs are generally higher than SPCs, with values more than 3-4 times the SPCs being considered worthy of seeking corrective measures. Values more than 50,000 should be of concern regardless of the SPC values. To obtain PICs, milk samples are held at 55°F for 18 hours prior to plating and counting the bacteria colonies. This process encourages the growth of bacteria that grow well at cool temperatures. High PICs are usually associated with milking cows that have not been properly cleaned prior to milking, or using milking equipment that is not properly cleaned and sanitized. Bacteria that are considered to be natural flora of the cow, including those that cause mastitis, are not thought to grow significantly at the PI temperature. Marginal cooling or prolonged storage times may also result in unacceptable PIC levels. PICs equal to or slightly higher than SPCs greater than 50,000 may suggest that the high SPC is possibly due to mastitis. The PIC of a raw milk supply does not usually indicate the potential quality of a pasteurized product made from that milk.

In summary, these two bacteria tests, as well as the other milk quality tests done on raw milk, serve as monitors for both regulators and producers to use as they attempt to produce the highest quality milk possible for consumers. For more information on production practices to follow to keep SPCs and PICs low, producers should contact their milk handler field representative or other qualified advisor.
Pay Attention to Cow Daily Resting Time

Researchers and many dairy consultants have been advising producers to be sure their cows have adequate resting time each day. The term “adequate” varies somewhat between advisors, but most would suggest that at least 12 hours are desired for proper cow health and maximum milk production. Many factors influence a cow’s ability and desire to lie down and rest. Among them are the design and comfort of the free stalls, the weather conditions, and the time required for the many routine activities a cow is involved in each day, e.g. milking, eating, drinking, etc., for which she must stand. Reports in recent issues of the Journal of Dairy Science have discussed other factors that affect the number of hours each day that cows will rest.

Wisconsin researchers studied the effects of different climatic conditions on cow lying time. They varied the temperature-humidity index (THI) from 56.2 to 73.8 in the pens which housed the cows, and found that the mean lying time decreased from 10.9 to 7.9 hours per day as the THI increased. Several researchers have shown that a THI of 72 or greater affects production, reproduction, and bovine physiology. The researchers noted that even the 10.9 hours was an inadequate amount of daily resting time, and was perhaps due to the location of the cooling fans and misters, the design of the free stalls, and the lameness status of the cows (especially towards the end of the summer season). As the THI increased and the cows spent less time lying in the stalls and more time standing, there was an increased risk factor for claw horn lesion development. At least in Wisconsin, the researchers have observed an increased incidence of cows with locomotion problems at the end of summer, a condition that could be associated with the cows standing more hours during the summer in an attempt to stay cool. Therefore, from their studies the researchers suggest that producers use more aggressive heat abatement strategies that are implemented/activated when the air temperature reaches around 70°F. Improving free stall comfort, properly locating fans and misters to cool cows, and minimizing the time cows are required to stand (e.g. in the parlor holding pen) are practices to consider.

Another group of researchers in British Columbia, Canada has reported on the influence of free stall overstocking rates on the amount of time daily that cows lie in stalls. They studied the overstocking rates of 109, 120, 133, and 150%. They also looked at the effect of the overstocking rates on which stalls (location in a row) got used most, and how much displacement activity occurred when there were more cows than stalls in the pen. They found that the hours spent daily lying in the stalls decreased from 12.9 at a 100% stocking rate to 11.5 and 11.2 hours, respectively, at 133 and 150% overstocking rate. These lower resting time values are less than the recommended minimum of 12 hours/day, and thus suggest that about 120% is the maximum overstocking rate that should be used. The researchers also found that cows kept in overstocked conditions were more likely to compete for stalls by lying down more quickly after milking, thereby not standing to eat fresh feed and have time for the teat sphincter muscles to close after each milking. The less desirable stalls were also used more per day as the overstocking rate increased.

These two reports support previous studies that show cows need at least 12 hours of resting time a day. Heat abatement practices, claw health influencing factors, and
overstocking rates are among the management practices that producers should review and perhaps change to improve their animals' performance and health.

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**Summer’s Impact Lingers Into Fall**

Summer weather in most parts of the country is a very stressful time for dairy cows. The high temperature and elevated humidity often cause cows to eat less, produce less milk, have more mastitis, and have lowered reproductive performance, among other things. When fall temperatures become cooler, most of these summer weather impacts usually disappear. However, there are some impacts that don't change or improve quickly. Rather, they can linger on for months, are costly, and require continuing management attention. Three lingering summer weather impacts that can have economic consequences are the following:

1) The increased incidence of both clinical and subclinical mastitis, as well as elevated herd somatic cell scores, often seen in the summer may continue for several weeks after the weather moderates in the fall. While the incidence of clinical mastitis cases may decline, subclinical mastitis cases may persist for several months, and may require treatment. The elevated herd somatic cell scores or counts that continue into the fall are a good indicator of the level of subclinical infection in the herd. Summer management practices that keep the free stall bedding clean and dry, that keep cows clean, and that cool cows can help shorten the recovery time. Following effective mastitis management and treatment programs for both dry cows and recently fresh cows should shorten the elevated somatic cell count recovery time. And don’t forget about how bred heifers are managed in the summer. Summer fly control practices and keeping heifers clean and dry are important factors in keeping the udders of fall freshening heifers free of udder infections.

2) Lowered reproductive performance can continue for several months into the fall as the cow’s reproductive system recovers from the summer heat stress. The physiologic changes that occurred in the cow due to the stressful weather must be corrected or healed, and this process can take several weeks to a few months after the weather cools. So, improvement in the conception rate may not occur until well into the fall. Following recommended practices to cool cows can reduce the lingering effects of summer heat stress, and can shorten the fall recovery time.

3) Cow hoof health and lameness problems that often show up in the late summer can often continue for several months into the fall. Cows standing in wet allies during the hot weather is one factor that can contribute to hoof cracks and infections, and can lead to lameness problems. This health issue will have a definite economic impact over time through reduced cow mobility, reduced feed intake, and reduced milk production.
These examples of lingering impacts of summer weather on cow health and productivity are issues that dairy producers should discuss now with their consultants so that by next summer they will have identified management practices that can be implemented to minimize the lingering impact of summer’s inclement weather.

Will Plants Help Control Mastitis?

Coliform mastitis is the most prevalent form of clinical mastitis in the U.S. dairy industry, with *E. coli* being the main bacterium causing the infections. Producers use various treatment methods, products, and regimes to reduce the severity of infections and to cure clinical cases. However, to date no “guaranteed” preventative or cure method or product has been found to eliminate this type of mastitis. Help in reducing the impact of this type of mastitis may soon become available, though, from a plant-derived protein.

Researchers at the USDA Agricultural Research Service labs in Beltsville, MD have been investigating the effects of a protein called “CD14” on coliform mastitis in cows. CD14 is known to help the immune system fight infection by binding to a component on the outer membrane of *E. coli* bacteria. However, since CD14 is normally present at very low levels in mammary glands, it has limited impact on fighting coliform infections. What the researchers have been able to do through bioengineering techniques using tobacco plants is to produce a large enough quantity of the CD14 protein to be able to test its effects on coliform mastitis cases in cows.

Tobacco plants were inoculated with a modified virus that caused the plants to produce the CD14 protein in significant quantities that were then extracted from the leaves. The extracted protein was infused along with a known number of colony forming units of *E. coli* bacteria into quarters of lactating cows. Saline and bacteria were infused into other quarters to serve as controls. Somatic cell counts were then determined on milk samples taken at various time points after the infusions. Quarters that received the CD14 plant protein had higher somatic cell counts than did the control quarters, indicating that the immune system was stimulated to fight the infused bacteria.

The researchers also conducted studies to determine if the CD14 plant protein could enhance the clearance of the *E. coli* from the quarter. As with the measurements for somatic cells, milk samples taken at various times after infusion were evaluated for the number of *E. coli* colony forming units (CFU) present. Milk from the quarters that received the plant protein had a significantly fewer number of CFUs excreted in the milk than did milk from the control quarters.

The researchers have applied for patent protection on the CD14 plant-derived protein, and are seeking commercial partners to conduct further testing for safety, effectiveness, and
proper dosage. If the product becomes commercially available in the next few years, it may first be used as a dry cow treatment. Infusing it at dry-off time along with a slow release carrier could possibly provide protection against *E. coli* caused mastitis throughout the dry period. It may also become a treatment method of choice for lactating cows since it is not an antibiotic. Since it could be produced rather easily in large quantities with a small number of plants, it should be a relatively low cost method of providing protection against one of the costliest health problems of dairy cows.

### Review Your Mastitis Management Program and Goals for Next Year

Dairy producers should conduct a yearly review of the mastitis management program and milk quality goals they have for their herd. They should evaluate and determine what changes to make for the year ahead to improve the quality of milk produced and udder health of their cows. People who should be involved in the review process are employees who work with the cows, the herd’s veterinarian, milk handler field representative, milking equipment dealer, extension specialist or agent, and other appropriate qualified consultants. Using a team to review the current program and goals will usually result in a more thorough review.

The review team should assess the current management level, milking practices, cow handling procedures, mastitis prevention practices, facilities, mastitis incidence rate, types of organisms causing mastitis, et cetera, as mastitis management practices and goals for the herd are reviewed, modified, or established. Goals that are established or modified should be realistic ones that can be attained in the year ahead. Members of the review team should be consulted as needed throughout the year when practices being used don’t seem to be working, when the mastitis incidence rate increases, or when the quality of milk produced declines. Use the expertise of your team members to help solve mastitis management problems that will occur.

A list of suggested mastitis management program goals is listed below. They are challenging goals that may take many months or longer to realize, but they are attainable.

- Not over 0.5% of the herd has milk discarded daily due to clinical mastitis
- Less than 12% of the cows and 5% of the quarters infected at any time
- Not over 3% of the herd culled yearly due to mastitis
- Less than 2% of the herd have new clinical cases per month
- Bulk tank milk somatic cell count (SCC) consistently less than 200,000/ml
- Bulk tank milk standard plate count (SPC) consistently less than 10,000/ml
- Never any antibiotic contamination of the bulk tank milk
- More than 85% of the herd consistently in the DHIA linear score of 4 or less
- Consistently receive available quality milk premium payments

Don’t let another year go by without taking the time and involving all the appropriate people...
and consultants in evaluating your management level, the practices you are following, and your herd’s performance. Besides conducting evaluations of your mastitis management program and its goals, also conduct reviews of all the other components of your dairy business, including your dairy’s financial performance, nutrition programs, herd health practices and performance, reproductive program and performance, milk production level, and personnel management. Only by taking time to yearly assess your current dairy business, preferably with the assistance of your competent consultants, and then to make the changes needed to improve your business, will you remain a viable, profitable dairy producer.

Dr. Brinton A. Hopkins
NCSU Extension Dairy Specialist

2007 State 4-H Dairy Judging Teams Compete at Contests in Pennsylvania, Wisconsin and Kentucky

Congratulations to both 2007 North Carolina State 4-H Dairy Judging Teams for an outstanding judging season. Coaches were Ken Vaughn (County Extension Director in Iredell County); Nancy Keith (County Extension Director in Yadkin County) Brad Johnson (Dairy and Livestock Extension Agent in Rowan County); and Dr. Brinton Hopkins (Extension Dairy Specialist).

State 4-H Team Members: Melinda Staebner (Yadkin County); Danielle Patterson (Randolph County); Caleb Knox (Rowan County); and Avery Lutz (Davie County).

Alternate State 4-H Team Members: Shelby Karriker (Rowan County); Ben Ketchie (Rowan County); Courtney Elliott (Randolph County); and Katie Wicker (Randolph County). Primary funding for the teams to travel and compete was generously provided by the North Carolina Dairy Youth Foundation.

Harrisburg, Pennsylvania Contest: Our state team placed 8th overall and 4th in reasons in the Pennsylvania Youth Dairy Cattle Judging Contest held in Harrisburg, PA. The team placed 4th in Holstein, 6th in Ayrshire, 9th in Brown Swiss, 8th in Guernsey, and 9th in Jersey. Individual highlights included: Melinda Staebner, 4th in overall reasons and 8th in Holstein; Danielle Patterson, 10th in Ayrshire; Avery Lutz, 9th in overall reasons; and Caleb Knox 13th in Guernsey. On the trip to Harrisburg, the team visited the Gettysburg battlefield and the North Carolina Memorial. While in Pennsylvania, the team also toured Hershey, PA and the Amish area in Lancaster County.

National 4-H Dairy Judging Contest held at the World Dairy Expo in Madison, Wisconsin: The state team traveled to Madison, Wisconsin and competed at the National 4-H Dairy Judging Contest held at the World Dairy Expo. Our state team placed 12th in total overall score and 13th in total reasons score out of 29 U.S. teams. The team placed 5th in Holstein; 3rd in Jersey; 8th in Guernsey; 17th in Brown Swiss and 22nd in Ayrshire. Individual highlights included: Melinda Staebner (3rd in Holstein, 4th in Guernsey, 22nd in Jersey and 24th in total reasons score); Danielle Patterson (10th in Holstein and 14th in Guernsey); Avery Lutz (15th in Guernsey); and Caleb Knox (17th in Jersey).

On the Saturday before the contest, our North Carolina State 4-H Team participated in practice judging sessions at Daltondale Ayrshires in Hartland, WI; Vilter Guernseys in Hartland, WI; Agnew Farm in Oconomowoc, WI and Crescentmead Holsteins in Ixonia, WI.
On the day before the contest, the teams had a great time participating with the other teams in touring dairy sites in Fort Atkinson, Wisconsin including NASCO, the Dairy Shrine, and the Hoard’s Dairyman Farm. They also participated in judging practice sessions at Sunshine Genetics, Inc. in Whitewater, Wisconsin and Barlass Jersey Farm in Janesville, Wisconsin. On the day following the contest, the team visited World Dairy Expo where they saw hundreds of dairy exhibits as well as some of the finest dairy cattle and dairy shows in the world.

North American 4-H Dairy Cattle Judging Contest in Louisville, KY: Congratulations to the Alternate State 4-H Dairy Judging Team for placing 11th out of 20 4-H teams in overall score and 12th overall in reasons in the North American 4-H Dairy Cattle Judging Contest in Louisville, KY. The team placed 2nd in Ayrshire, 9th in Brown Swiss, 12th in Holstein, 10th in Guernsey and 14th in Jersey. Individual highlights included: Katie Wicker placed 4th in Ayrshire and 8th in Brown Swiss; Courtney Elliott placed 11th in Ayrshire.

North Carolina State 4-H Dairy Quiz Bowl Team Competes at 2007 North American Contest in Kentucky

Congratulations to the Rowan County 4-H Dairy Quiz Bowl Team who did an great job representing North Carolina and competing at the North American 4-H Dairy Quiz Bowl Contest in Louisville, Kentucky. Team members included Shelby Karriker, Ben Ketchie, and Hannah Hursey. Brad Johnson (Rowan County Dairy and Livestock Extension Agent), and David and Cheryl Correll (Rowan County 4-H Dairy Volunteers) served as coaches.

North Carolina Youth Participate in the 2007 National 4-H Dairy Youth Conference at the University of Wisconsin-Madison

Congratulations to Brittany Sturgill (Alleghany County) and Carrie Hoffner (Rowan County) for being selected, through an application and interview process, to attend the National 4-H Dairy Conference that was held on the University of Wisconsin-Madison campus. Dr. Brinton Hopkins, Extension Dairy Specialist and Shelley Lutz, dairy volunteer leader from Treasure Chest Jerseys in Lincoln County, accompanied the youth to this conference.

Youth from across the United States and certain provinces of Canada participated in this educational conference that was held at the University of Wisconsin-Madison during World Dairy Expo. At the conference, youth participated in many outstanding educational sessions and seminars on the University of Wisconsin-Madison campus and visited several dairy farms, a commercial dairy heifer grower farm, ABS headquarters and the World Dairy Expo. They also toured the new dairy facility at Hoard’s Dairyman Farm, Hoard’s Dairyman publishing company, the National Dairy Shrine and NASCO. Ryan Sloop (Rowan County) also attended this conference serving as one of two youth representatives on the national planning committee for the 2007 conference. Funding for our youth to attend this conference was generously provided by the North Carolina Dairy Youth Foundation and the North Carolina State University Department of 4-H and Youth Development.
North Carolina Dairy Producers Association
Officers and Directors for 2007

Officers and Directors

President
Norman A. Jordan, Jr., Siler City

Vice President
Wayne Lutz, Mocksville

Secretary
Rex Bell, Statesville

Treasurer
Neal Grose, Harmony

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Neal Grose
Wayne Lutz
Russ Seibert
Dr. Ben Shelton
George Teague

Term Ends February, 2009:
Norman Jordan, Jr.
Dennis Leamon
H. Leigh Lane
George Smith
Zach Myers

Term Ends February, 2010:
Rex Bell
Jeff Bender
Mike Corn
Daniel Horton
Neal Johnson

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Dewitt Hardee
Chester Lowder
Dr. Lon Whitlow
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<th>Mr. Robert Paxton</th>
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<td>Dr. Todd Klaenhammer</td>
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<td>Mr. H. Leigh Lane</td>
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<td>Mr. Clifford Loflin</td>
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<td>Mr. Corey Lutz</td>
<td>Mr. Mike Todd</td>
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<td>Mr. Kenneth Wright</td>
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<td>Ms. Kathy Hart</td>
<td>Mr. Dwayne Myers</td>
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<td>Mr. Doug Holland</td>
<td>Mr. Keith Pardue</td>
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## Members of the North Carolina Dairy Youth Foundation
### Board of Directors For 2007-2008

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<thead>
<tr>
<th>Name</th>
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<tr>
<td>Mr. Johnny Brooks</td>
<td>2009</td>
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<td>Mr. Ronnie Charles</td>
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<td>Mr. David Correll</td>
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<td>Mr. Vance Dalton</td>
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<td>Ms. Marti Day</td>
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<td>Mr. Robert Hardin III</td>
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<td>Mr. Mike Helms</td>
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<td>Mr. Lonnie Hoffner</td>
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<td>Dr. Brinton Hopkins</td>
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<td>Mr. Jim Howie</td>
<td>2008</td>
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<td>Mr. Brad Johnson</td>
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<td>Mrs. Jill Karriker</td>
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<td>Mrs. Nancy Keith</td>
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<td>Mrs. Amy Kidd</td>
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<td>Mr. Ted Luther</td>
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<td>Mrs. Shelley G. Lutz - Secr.</td>
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<td>Mr. Wayne Lutz (Vice-President)</td>
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<td>Mrs. Robin Mann</td>
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<td>Mr. Tony McGaha</td>
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<td>Mr. Roy Mitchell</td>
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<td>Mrs. Sybil Myers</td>
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<td>Mrs. Kathy Shambley</td>
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<td>Mr. Ken Vaughn - Treas.</td>
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<td>Dr. Lon Whitlow (Ex-officio)</td>
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<td>Mr. Jason Wright</td>
<td>2010</td>
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<td>Mr. Keith Oakley (Dairy Foundation)</td>
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SUDIA/ADA of NC
Southeast United Dairy Industry Association, Inc.
American Dairy Association of North Carolina
2008 Board of Directors

Directors
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Eugene Blackwell, Oxford, NC
Bill Chapman, Taylorsville, NC
David Coltrane, Pleasant Garden, NC
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Andy Gray, Stony Point, NC
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Doug Sockwell, Gibsonville, NC
Ricky Talley, Olin, NC
Darrell Wright, Franklinville, NC

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Jimmy Gentry, Statesville, NC (NC State Grange)
Dr. Todd Klaenhammer, Raleigh, NC (SE Dairy Foods Research Center)
Chester Lowder, Raleigh, NC (NC Farm Bureau Federation)
Dr. Ed Jones, Raleigh, NC (NC Coop. Extension Service)
Jim Howie, Waxhaw, NC (MD/VA MPA)
Carlyle Teague, Raleigh, NC (Coop. Council of NC)

For more information about NC advertising, promotion and nutrition education programs, please contact:
Mr. Eric McClain, SUDIA Industry Relations Manager
9201 Bunsen Parkway, #100
Louisville, KY 40220, phone: (502) 495-7760
The United Federation of DHIA

General Manager:

Mr. Sam Chafin
Address: 2300 Litton Reaves Hall, Blacksburg, VA 24061-0315
Phone number: 1-800-367-3442

Officers and Directors for 2007-2008:

President: Glenn Easter, Laurens, SC, (864) 682-2003
Vice President: Rex Bell, Statesville, NC, (704) 872-9638
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Director: Coy Reese, Taylorsville, NC, (828) 632-5548
Director: Robert Pemberton, Ashland, VA, (804) 798-2648
Director: George Rohrer, Dayton, VA, (540) 867-5168
Director: George Teague, Elon, NC, (336) 449-4883

Dairy Records Management Systems (DRMS)

Director: Dr. John Clay

Address: 313 Chapanoke Road, Suite 100, Raleigh, NC 27603
Administrative support/main telephone number: (919) 661-3100
Computer support telephone number: (919) 661-3120
The Marvin E. Senger Distinguished Dairy Farmer Award is a program that was established by the Department of Animal Science at North Carolina State University in 1974 to honor Dr. Marvin E. Senger, long-time and highly respected dairy Extension specialist in the department. The award is presented yearly at the NC Dairy Conference to an outstanding dairy leader, family, or farm business. Nominations are submitted to the Department by anyone who cares to. An anonymous committee from the Department reviews the applications and selects the recipient. Criteria used in evaluating the applications and selecting the winner include 1) leadership in dairy, farm and community organizations at the local, area, state, regional and national levels, 2) leadership in business and production management practices used, and 3) leadership in the use of modern technology. Printed below is a listing of the recipients.

1974 - Franklin Teague
1975 - S. F. Nesbit
1976 - Thomas L. Reeves
1977 - S. E. Johnston, Jr.
1978 - Douglas Darch
1979 - G.C. Palmer
1980 - J. Woodley Wallace
1981 - Albert M. Clark
1982 - W. Glen Caruthers
1983 - Robert J. Davis
1984 - Charles Spurgeon Brooks
1985 - David C. Knox
1986 - William F. Covington
1987 - J. B. Stroup
1988 - Eston S. Stokes
1989 - H. L. "Doc" Hill
1990 - C. M. "Mac" Ivey
1991 - Charles and Ethel Lutz and Family
1992 - Beecher H. Gross, Sr.
1993 - Bobby R. And Sara Atkins
1994 - Jim and Charles Eaton
1995 - James M. Cook
1996 - Sam and Eubert Correll
1997 - Robert and Lucy Crowell
1998 - Daniels and Daniels Dairy, Inc.
1999 - Maple View Farm, Inc.,
Robert and Chris Nutter
2000 - Norman Jordan, Jr.
2001 - Dwayne Myers
2002 - Keck’s Dairy, Inc.
2003 - G.K. and Ken Davis Dairy
2004 - Branson, Kay, David, Amy & Will Coltrane
2005 - George L. Pless and Sons Dairy, Inc.
2006 - Wayne Lutz
2007 - Vance C. Proctor, Jr.
2008 – H. Leigh Lane, Stepstone Holsteins
Don Wesen Quality Milk Producer Award Program

The Don Wesen Quality Milk Producer Award is a program sponsored by the North Carolina Dairy Producers Association to recognize producers in three herd size categories who have consistently produced the highest quality milk the previous calendar year. Yearly average bulk tank somatic cell count and bacteria count values, as well as the ranges in the monthly values, are reviewed to select the recipients. The award is named after Dr. Don Wesen who was a widely known and well respected milk quality dairy extension specialist in the Department of Animal Science at NC State University. Printed below is a listing of the recipients.

1996
<100 cows: H. Durayne Hood, Vale
100-250 cows: Carroll and William Roper, Morganton
>250 cows: Tony Nesbitt, Fletcher

1997
<100 cows: Wayne Stout, Stony Point
100-250 cows: Triple R Dairy, Waynesville
>250 cows: Dwayne Myers Dairy, Jonesville

1998
<100 cows: Wayne Stout, Stony Point
100-250 cows: Triple R Dairy, Waynesville
>250 cows: Dwayne Myers Dairy, Jonesville

1999
<100 cows: Wayne Stout, Stony Point
100-250 cows: Ralph Ross and Sons Dairy, Waynesville
>250 cows: Dwayne Myers Dairy, Jonesville

2000
<100 cows: Ruffus Holland and Sons, Olin
100-250 cows: T.C. and Charles Williams, Union Grove
>250 cows: Dwayne Myers Dairy, Jonesville

2001
<100 cows: Wayne Stout, Stony Point
100-250 cows: Ralph Ross and Sons Dairy, Waynesville
>250 cows: Dwayne Myers Dairy, Jonesville

2002
<100 cows: Wayne Stout, Stony Point
100-250 cows: Dean Ross, Waynesville
>250 cows: H.C. Meyers, Jr. (Myers Farms, Inc.), Union Grove

2003
<100 cows: Randy Lewis, Snow Camp
100-250 cows: Triple R Dairy, Waynesville
>250 cows: Dean Ross, Waynesville

2004
<100 cows: Randy Lewis, Snow Camp
100-250 cows: Triple R Dairy, Waynesville
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<100 cows: Randy Lewis, Snow Camp
100-250 cows: Triple R Dairy, Waynesville
>250 cows: Dean Ross, Waynesville

2007
<100 cows: Wayne Stout, Stony Point
100-250 cows: Triple R Dairy, Waynesville
>250 cows: Dean Ross, Waynesville

2008
<100 cows: Neal Grose, Harmony
100-250 cows: Dean Ross, Waynesville
>250 cows: Myers Farms, Inc., Barry Myers, Union Grove
The North Carolina Dairy Producers Association, which was officially organized in February 1996, each year recognizes at their annual meeting one or more individuals for their outstanding contributions to the dairy industry of the state. Printed below is a listing of the recipients.

1997 – Dr. Fred Knott
1998 – W. Clyde Daniels
1999 – Dr. Frank D. Sargent
2001 – J. D. Brooks
2002 – Dewitt Hardee and W. Chester Lowder
2004 – Dr. Lon W. Whitlow
2005 - Franklin Teague
2006 – Kenneth E. Vaughn
2007 – Dr. Geoffrey A. Benson
2008 – Dr. Don Pritchard
Tuesday, January 22
NC Dairy Organizations Meetings
----------------------------------------------------
1:00 - 5:00 p.m.
Dairy Foods Safety and Quality Conference
- Jackson Room

1:30 p.m.
NC ADA/SUDIA Board Meeting
- Steele Room

2:00 p.m.
NC Dairy Youth Foundation Board Meeting - Suite 102

7:00 p.m.
North Carolina Dairy Producers Association
13th Annual Meeting
- Steele Room

- President’s Report by Norman Jordan, Jr.
- Comments by NCDA&CS Asst. Commissioner Howard Isley
- Presentation on the NC Dairy Biosecurity Committee’s FMD Business Continuity Plan by NCDA & CS Representative
- NCDPA Board Reorganization meeting

Wednesday, January 23
57th Annual North Carolina Dairy Conference Program
“Planning For Tomorrow”
--------------------------------------------------------
8:30 a.m.
Registration and View Exhibits

9:50 a.m.
Morning Session: Steele Room
Chair: Norman Jordan Jr., President, NC Dairy Producers Association

Presentation of Don Wesen Quality Milk Producer Awards - Kay Sigmon, NC Milk Sanitation Program Asst. Branch Head, and Norman Jordan Jr., NCDPA President

10:00 a.m.
“The Benson Report”
- Dr. Geoff Benson, NCSU

10:15 a.m.
SUDIA Report – New Directions - Partnerships and Progress - Cheryl Hayn, General Manager, and Eric McClain, Industry Relations Manager

11:00 a.m.
“Coping With a FMD Outbreak”
- Mr. Jim Howie, Dairy Biosecurity Comm.

11:10 a.m.
Presentation of the Marvin E. Senger Distinguished Dairy Farmer Award
- Dr. Roger McCraw, Head, Department of Animal Science, NCSU

11:30 a.m.
Luncheon Session:
Jackson & Overman Rooms
Chair: Ronnie Charles, President NC Dairy Youth Foundation
- Buffet Lunch
- Dairy Youth Foundation Report and Raffle Drawing

“What Will A Successful Dairy Look Like In 10 Years”
- Dr. Mark Stevenson, Cornell University

View Exhibits

2:00 p.m.
Afternoon Session: Steele Room
Chair: Leigh Lane, Past Chairman, NC Dairy Foundation

“Programs That Are Assisting Dairy Producers In Wisconsin and Pennsylvania”
- Mr. Matt Lange, WI Dept Agriculture, & Mr. Zach Myers, NC Dairy Producer

2:30 p.m.
North Carolina Dairy Industry Stabilization and Growth Strategic Plan

2:55 p.m. Drawing for door prizes

3:00 p.m. Adjourn