ADSA-SAD Undergraduate Competition: Dairy Production

182 Glucose transporter and hypoxia-associated gene expression in the mammary gland of transition dairy cattle. C. N. Niewiadomski,* S. A. Mattmiller, and E. L. Karcher, *Michigan State University, East Lansing.*

Glucose is an important energy substrate needed by transition dairy cows postpartum to support the onset of lactation. The prioritization and regulation of glucose uptake is accomplished in part by shifts in cellular glucose transport molecules (GLUTs) within the mammary gland (Zhao and Keating, 2007). These shifts have been demonstrated in rat (Abdul et. al., 1996), mouse, bovine mammary epithelial cells (Zhao and Keating, 2007), and in bovine mammary endothelial cells (BMECs), which are responsible for transport of glucose from the blood. Additionally, increased metabolic activity of the lactating mammary gland causes a decrease in oxygen, a physiologic state referred to as hypoxia, which can also affect the mammary vasculature and potentially glucose utilization. While Zhao et al. (1996) described GLUT expression on epithelial cells, Mattmiller et al. (2010) evaluated for the first time, expression, localization, and functionality of GLUTs and hypoxic associated-genes over the transition period in bovine mammary endothelium. Significant shifts were observed in gene expression of the GLUTs and some of the hypoxia-associated genes evaluated. GLUT1, 3 and 4 were detected on cultured BMECs and shown to be functional. A better understanding of glucose uptake at the endothelial level could prove to be critical to improve glucose absorption and utilization in the mammary gland.

Key Words: GLUT, hypoxia, endothelium

183 Challenges and inconsistencies associated with goat somatic cell counts. K. M. Wolf* and J. M. Bewley, *University of Kentucky, Lexington.*

Goat somatic cell counts (SCC) are considerably higher than cow SCC, which presents a troubling issue for dairy goat producers. Most states have adjusted SCC regulations for goats to allow for this discrepancy. However, because high SCC are typically an indication of an intramammary infection caused by bacteria, elevated goat SCC still present challenges. An increased understanding of the factors affecting SCC and physiological differences between does and cows is needed. Nonpathogenic factors known to contribute to SCC in both species include stage of lactation, animal age, and milking frequency. Goats have several unique characteristics that contribute to elevated SCC. First, unlike cows, most does are seasonal breeders, with estrus occurring only a few months each year. Second, over 65% of the goat population produces antibodies for the caprine arthritis encephalitis (CAE) virus. A primary symptom of CAE is the presence of interstitial mastitis. Additionally, production of antibodies may be correlated with higher SCC, regardless of the presence of an actual infection. A 1997 study involving 1,799 goats from 66 herds demonstrated that first-lactation CAE-negative does had higher SCC than first-lactation CAE-positive does. SCC for CAE-positive does increased significantly through subsequent lactations, and SCC for CAE-negative does did not increase. Another significant difference between goats and cows is in the actual mammary gland physiology. In goats, milk is produced via apocrine secretion. In this type of secretion, a cytoplasmic fragment of the secreting cell is released with the milk fat. Each cell fragment may contribute to a higher SCC with certain cell counting methods. To contrast this, cow milk production occurs by alveolar merocrine secretion, which does not contribute to SCC. Thus, increased goat SCC is caused by goat-specific characteristics not necessarily associated with intramammary infections caused by bacteria. While goat dairy operators should still try to minimize SCC and clinical mastitis, physiological differences may necessitate different standards for goat SCC.

Key Words: goat, somatic cell counts

184 On-farm culturing as a new management practice. A. Patch,* D. Winston, I. Mullarky, and C. Petersson-Wolfe, *Virginia Tech, Blacksburg.*

On-farm culturing (OFC) of milk, an increasingly popular management technology, uses microbiological cultures to identify mastitis-causing pathogens present in a dairy herd. Pathogen identification is usually completed within 24 to 28 h of sampling. Researchers evaluated 2 types of OFC, the University of Minnesota Tri-plate and the 3M Petrifilm; the practicality of materials needed, as well as sensitivity, specificity, and ability to interpret results was examined. This experiment evaluated the ability of 3M petrifilm to correctly identify *Staphylococcus aureus*, with the addition of the Staph express disk (STX disk) to verify the presence of the pathogen. The University of Minnesota Tri-plate was used to identify *Streptococcus* spp. and *S. aureus*. The sensitivity and specificity of the Tri-plate for the classification of *S. aureus* were 97.9% and 81.8%, respectively. The classification of *Streptococcus* spp. using the Tri-plate yielded a sensitivity and specificity of 92.6% and 89.5%, respectively. The addition of the STX disk on the Petrifilm improved the specificity of *S. aureus* detection from 76.1% to 93.1%. In contrast the sensitivity was 97.4% without the use of the STX disk and 92.1% with the addition of the STX disk. Based on the high sensitivity and specificity values of the Petrifilm system with the STX disk and the Tri-plate system to identify *S. aureus* and the Tri-plate system to identify *Streptococcus* spp. both systems are appropriate tools to identify common gram-positive mastitis-causing pathogens in milk. Using OFC to identify cows with mastitis caused by *S. aureus* and *Streptococcus* spp. may lead to decreased use of antibiotics.

Key Words: culturing, mastitis, pathogen

185 New approaches to combat milk fat depression. J. M. Risser* and D. R. Olver, *Pennsylvania State University, University Park.*

Diet-induced milk fat depression (MFD) has been observed for well over a century. MFD is characterized by a drastic decrease in milk fat yield with little to no change in milk production or other milk components. MFD often results from diets supplemented with high levels of oil, especially those derived from plants or fish, or those containing highly fermentable feeds. According to a study at Michigan State University, highly fermentable diets may decrease intake and fiber digestibility and lead to synthesis of bioactive trans fatty acids in the rumen that are known to reduce milk fat synthesis. However, highly fermentable diets are important to maximize energy intake and milk production. With rising input costs, dairy producers require new ways to maximize milk production while ensuring high yield of components. Recent developments have pointed to modifiers of the rumen environment to combat MFD even when feeding rapidly fermentable and high concentrate diets. One example of a rumen modifying additive is yeast culture. Michigan

State researchers found that yeast culture supplementation may assist in the prevention of MFD when transitioning to a diet containing highly fermentable starch. Yeast cultures are responsible for stabilizing rumen fermentation during diet shifts by increasing the population of lactate-utilizing microorganisms, thus maintaining an environment for normal fermentation. In addition to yeast culture supplementation, dietary molasses also has a role as a rumen modifier. Through research at Kansas State, molasses has been shown to change fatty acid biohydrogenation pathways in the rumen, and reduce the synthesis of bioactive fatty acids that cause MFD. These additives, among other rumen modifiers, can lead to more efficient dairy cows by stabilizing rumen fermentation while simultaneously increasing profit for the producer.

Key Words: milk fat depression, rumen modifiers

186 Monitoring the composition of waste milk fed to dairy calves. E. L. Stayduhar,* K. D. Stevens, M. L. Eastridge, and K. M. Daniels, *The Ohio State University, Columbus.*

Profitability of dairy farms is influenced by several characteristics, one of which is calf management. The growth and health of replacement animals influences their future milk yield. With the increasing size of dairy farms and the aim to reduce costs of raising heifers, many farms are opting to pasteurize waste milk for feeding to calves. With this shift from feeding milk replacer to pasteurized waste milk, the cost of pasteurizers has decreased. However, when using this feeding practice, the producer needs to know the composition of the milk being fed. The proportion of milk from fresh cows and cows treated for mastitis (often lower in solids than from healthy cows) will affect the composition of the waste milk. Adequate concentrations of fat and protein (or total solids) in the milk is vital for sound health and expected growth rates for the calves. Simple tests, such as pH and ethanol coagulation, can be easily used, but they only indicate whether or not the waste milk has spoiled. Other on-farm measurements are needed that are more reflective of milk composition. Total solids in milk can be determined using a Brix refractometer, with the Brix readings being converted to total solids using reported equations. In addition, these refractometers are inexpensive and the readings are very rapid. On-farm analytical instruments are available today for measuring the fat, protein, and other solids in milk (e.g., LactiCheck; Page and Pedersen International Ltd., Hopkinton, MA). These instruments require routine calibration, but standards for the calibration are readily available and the calibration steps are simple. Although these instruments are much more expensive than refractometers, they provide more information than just total solids and they can be used to monitor the composition of milk from individual cows (e.g., milk fat concentration for ketosis risk) and the bulk tank. Using the methods described to measure total solids or fat and protein concentrations allows the producer to fortify waste milk with the appropriate amount of milk replacer to increase total solids to the desired level. Continued improvement in on-farm measurement of the composition of waste milk fed to calves will improve calf performance and increase farm profitability.

Key Words: waste milk, calves, milk composition

187 Early pregnancy detection methods in reproductive management. C. E. Burke* and C. C. Williams, *Louisiana State University, Baton Rouge.*

In the cattle industry, pregnancy diagnosis is an important tool in measuring the success of reproductive management. A cow that remains open longer than desired will ultimately cost the producer, whether it is money spent on synchronization and breeding materials or simply the cost to keep her in the herd. To reduce economic losses, producers rely on early pregnancy detection to better manage the reproductive efficiency of the herd. Today many producers use synchronization programs to aid in the breeding process. The hormone prostaglandin is given to an animal to regress its corpus luteum (CL) and cause her to cycle, setting her up for breeding. When a cow is pregnant her CL will remain throughout her pregnancy, preventing her from cycling. One of the many disadvantages of not knowing pregnancy status is mistakenly causing the cow to abort by treating her with prostaglandins as if she were open. The 2 most common methods of pregnancy detection are rectal palpation and ultrasonography, both of which are very invasive procedures. Although these methods are used extensively throughout the industry, there is a new method providing a friendly, cost effective way to detect early pregnancy. Blood pregnancy tests such as BioPRYN simply test for pregnancy specific protein B in the blood rather than relying on invasive practices. BioPRYN uses ELISA technology that requires only a sample of blood from the cow under question. At a price of less than $3 per test, BioPRYN is a cost effective alternative that does not require a trained technician. With labs throughout the United States and internationally, a producer can send in samples and have their results within 27 h of assay setup. Cows must be 90 d postpartum and 30 d post breeding to get an accurate reading. BioPRYN offers up to 95% specificity on pregnant cows and 99% sensitivity on open cows. Blood testing for pregnancy is the next step in improving the reproductive management systems in cattle herds. The earlier a pregnant or open status can be confirmed, the sooner the producer can take the necessary steps to safely and properly manage his herd.

Key Words: pregnancy detection, reproductive management, blood test

188 Anaerobic digestion and the benefits to dairy farmers. S. K. Luther,* A. C. Wilkie, and M. E. Sowerby, *University of Florida, Gainesville.*

Anaerobic digestion has the potential to be a large part of the solution for shrinking our fossil fuel consumption. Anaerobic digestion is a biological process that turns waste into fuel and resources. It is essentially the breakdown of organic materials using a mixed consortium of bacteria in the absence of oxygen. Anaerobic digestion is a full circle process that captures the remaining energy in feedstocks that are currently considered waste and gives back usable goods. On the farm, anaerobic digestion has the ability to produce combustible methane gas and efficient fertilizer. The methane produced is collected and when used eliminates the carbon dioxide that would have been released from the fossil fuels that the methane can replace. With all the hype over going "green," farmers need to be doing all they can to improve their public image and conserve the environment for future growers. As businessmen, dairy farmers can turn their digester output into renewable biofuel, carbon credits, and fertilizer. Anaerobic digestion is a very effective waste management practice on farms that already have manure collection systems in place. It helps to reduce odors normally associated with spray fields and lower pathogen levels in the animal manure that is digested. Anaerobic digestion inactivates "weed" seeds and conserves nutrients, making the liquid effluent a valuable biofertilizer. Dairy farmers must consider herd size, current waste management methods, and possible farm expansion when choosing and sizing a digester. There are 4 main types of digesters, which are each suitable for different manure management methods. For example, one type of digester was specifically designed for the flushing systems used in dairy freestall barns. Anaerobic digestion is a technology that will further contribute to our sustainability efforts while improving the relationship between agriculturalists and consumers. The process

captures the energy in feedstocks that are currently considered waste and delivers usable goods.

Key Words: anaerobic digestion, manure management, digester designs

189 Supplemental melatonin: A potential strategy for maintaining mammary health in dairy cattle. M. M. Palmer,* D. N. Williams, and J. L. Fain, *Clemson University, Clemson, SC.*

Increased somatic cell count (SCC), associated with mastitic infections in dairy cattle can have detrimental effects on animal welfare, reproduction, milk quality and overall milk production. Novel investigations have established melatonin as a potential potent regulator of SCC in dairy cattle. Seasonal response patterns in estrous cycles of small ruminants led to the increased use of melatonin implants to regulate incidences of anestrus during periods of increased day length. Consequently, producers noticed a reduction in SCC in both sheep and goats. Previous work indicates that melatonin acts to protect cells and tissues against damage caused by oxidation. During the inflammatory reaction associated with mastitis, there is damage that occurs to the mammary epithelium. The somatic cell composition changes from a majority macrophage concentration to increasing levels of polymorphonuclear neutrophils (PMN) moving from the blood stream to congregate in the mammary gland during times of infection. These PMNs then engulf the invading pathogen through phagocytosis. During this process, the neutrophils release reactive oxygen species (ROS) which defend against invading pathogens but also trigger epithelial cell damage. Melatonin has demonstrated abilities to scavenge hydroxyl radical, a noted ROS. Serving in an antioxidant capacity, melatonin may be used to supplement the animal's endogenous mechanisms, allowing for faster rate of recovery with reduced total tissue damage. With potential decrease in legal limit SCC, faster recovery rates from mastitis could decrease bulk tank SCC. An even larger impact may be the potential for melatonin to abrogate decreased milk production associated with increased SCC through reduction in tissue damage. Continuous investigation of melatonin and other antioxidents may allow for more insight into their role in maintaining mammary health.

Key Words: melatonin, mastitis, dairy