Using dietary strategies to improve dairy cattle health and productivity

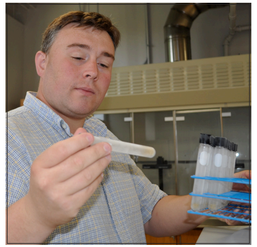
Michigan's 1,500 dairy farms produced more than 11 billion pounds of milk in 2017, placing the state fifth in the nation in milk production. Adam Lock, an associate professor in the Michigan State University Department of Animal Science, is working to help producers increase the value of their product amidst currently suppressed milk prices.

Lock arrived at MSU in 2009, bringing with him a research program focused on both animal and human nutrition and the effects on overall health. Within animal agriculture, he is interested in the effect of diets on milk production, particularly the supplementation of different fatty acids to boost animal health and productivity.

Supplementing diets with fat is a common practice on dairy farms to support milk production. With assistance from several grants from the Michigan Alliance for Animal Agriculture (M-AAA), Lock has pursued a better understanding of the types of fatty acids that would be the most effective. He is also delving into the uncharted territory of evaluating the long-term effects of palmitic acid supplements on dairy cattle health and productivity, hoping to determine the potential role of supplemental fatty acids in very early lactation.

"The dairy industry has deep roots in Michigan agriculture, and my research is trying to continue this tradition through maintaining and enhancing its economic viability," Lock said. "Dairy producers and their nutritionists are highly engaged in the research, and that makes for a great partnership."

The objective of his first M-AAA project was to determine the effects of three commercially available fat supplements



on the yield of milk and milk components, and feed efficiency. Lock observed that a diet supplemented with a palmitic acid-enriched fat increased the yield of milk fat and protein, while a diet supplemented with a fat containing a mixture of palmitic and oleic acids increased body weight gain.

Based on 2016 Michigan milk prices, feeding a palmitic acid-supplemented diet would increase gross income by 81 cents per cow, per day. After accounting for the price of the supplement, this would translate to an increase in income of over $75,000 per year on a 500-cow dairy farm.

In a 2017 project, Lock began to look at developing effective strategies to maximize the yield and efficiency of milk production while optimizing body fat reserves. This promotes cow health and reproductive performance, as well as increasing milk income and farm profitability.

The goal was to determine the long-term effects of palmitic acid supplements on the yield of milk and milk components, nutrient digestibility, energy intake, body weight, feed efficiency, adipose tissue composition and indicators of inflammation.

Lock observed that production responses of dairy cows to palmitic acid supplementation were consistent throughout the 10-week treatment period and had carryover effects on the yield of milk fat. Overall, the palmitic acid supplement improved digestibility, milk yield, milk fat yield and feed efficiency in mid-lactation dairy cows.

"Our results had immediate impact on dairy industry recommendations and strategies to increase milk component yields, and will enable us to positively influence dairy cattle production efficiency and farm income," Lock said. "We have already engaged with on-farm nutritionists and technical consultants with results being communicated at local, regional and national dairy nutrition consultant and farmer meetings."

For a 100-cow herd, Lock said, this is worth a roughly $5,000 per month income jump during summer months. Factoring in feed costs for the supplement, this would still represent a rate of return of over 3 to 1.

Additionally, Lock is leading ongoing projects through M-AAA and has received funding for 2019.

"We've delivered results, and feedback from the industry has been very favorable," Lock said. "Partnering with the industry through M-AAA has been invaluable. Nutritionists have implemented feeding strategies based on this research, and that's what makes my work so rewarding."

Economic Impact of Research

"We really value the ability to help direct university research toward issues that are affecting farmers today. Serving as one of the reviewers allows me the opportunity to make sure the funded research proposals are benefiting today's farming needs and future challenges. Farming has changed over the years, and we need to continue to find ways to raise more food in a safer, more sustainable manner to feed our growing populations."

Mary Kelpinski
Chief Executive Officer of the
Michigan Pork Producers Association

Source: USDA Economic Services

Thank You, Industry Partners!

Research through the Michigan Alliance for Animal Agriculture would not be possible without the support of the animal agriculture industry. This partnership is critical to making advancements that allow the industry to grow and flourish.

- Michigan Allied Poultry Industries
- Michigan Cattlemen's Association
- Michigan Farm Bureau
- Michigan Horse Industry
- Michigan Meat Association
- Michigan Milk Producers Association
- Michigan Pork Producers Association
- Michigan Sheep Producers Association
- Michigan Soybean Promotion Committee (associate member)
- MSU AgBioResearch
- MSU College of Agriculture and Natural Resources
- MSU College of Veterinary Medicine
- MSU Extension

Michigan Alliance for Animal Agriculture

2018 Legislative Summary

Developing research, outreach and educational programs.

Ensuring and improving food safety.

Protecting the environment.

Improving workforce development.

MESSAGE FROM M-AAA LEADERSHIP

Ronald Bates

George Smith

In 2019, we enter the fifth year of the Michigan Alliance for Animal Agriculture (M-AAA). Continued support from the state of Michigan, commodity groups and Michigan State University (MSU) has propelled the initiative to new heights, offering increased opportunities to grapple with some of animal agriculture's most pervasive challenges.

From evaluating and improving worker training on dairy farms to promoting environmental sustainability, MSU researchers and Extension educators have been on the forefront of many urgent concerns.

Recommendations based on M-AAA studies are being delivered to producers, and the feedback has been resoundingly positive. This speaks to the value of our partnerships with the animal agriculture industries, a collaboration that gives valuable insight to help to set research priorities.

This report contains updates on completed and ongoing M-AAA projects, which cover several of our important animal agriculture commodities.

Madonna Benjamin, an assistant professor in the MSU College of Veterinary Medicine and a swine veterinarian with MSU Extension, is exploring sow health and welfare amidst impending group housing requirements. She is developing a low-cost and noninvasive imaging technology used to assist pork producers with economic decisions regarding removal of animals from the herd, feed allocation and treatment linked to improved animal welfare.

Adam Lock, an associate professor in the MSU Department of Animal Science, is working with dairy farms on nutritional strategies to increase milk fat content, which impacts the value of milk and profitability.

Jeff Andresen, a professor in the MSU Department of Geography, Environment and Spatial Sciences, and Michigan's state climatologist, is using data to make more informed siting decisions for new and expanding animal agriculture operations. Using a web-based decision support tool, producers can enter odor emission information and search odor footprints by location. This will allow producers to choose more optimal locations for their facilities.

These projects are great representations of the M-AAA's four main priorities:

- Develop research, outreach and educational programs.
- Ensure and improve food safety.
- Protect the environment.
- Improve workforce development.

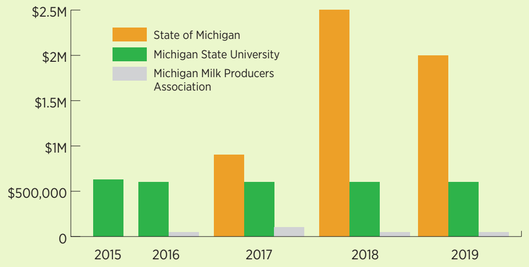
In 2019, researchers are continuing to delve into important, timely issues for producers. Twenty projects will be funded in the areas of research, extension and seed grants. For a complete list of these projects, visit **maaa.msu.edu**.

We wish to thank the state of Michigan, our industry partners and our colleagues at MSU for their unwavering commitment to improving animal agriculture — addressing improved profitability, sustainability and environmental stewardship.

Sincerely,
George Smith
Associate Director, MSU AgBioResearch
Associate Dean for Research, MSU College of Agriculture and Natural Resources

Ronald Bates
Director, Agriculture and Agribusiness Institute, MSU Extension

In 2019, $2.6 million is committed to support research and extension programs for Michigan's agriculture industry.



LEADERSHIP TEAM

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Michigan Milk Producers Association

George Quackenbush
Michigan Cattlemen's Association

George Smith
Michigan State University

Development of low-cost biometrics of sow body composition and locomotion to improve individual sow health and welfare

Madonna Benjamin
Assistant professor, Department of Large Animal Clinical Sciences
Swine veterinarian, MSU Extension

As of April 1, 2020, sows in Michigan will be required to be housed in group pens for the majority of their pregnancies. These close quarters often create conflict, as sows aggressively compete for feed. A pecking order is established, resulting in loss of body mass for submissive sows. The objectives of the project were to develop a practical software program utilizing low-cost, noninvasive and low-labor imaging technology that can be used to improve sow welfare, as well as assist Michigan pork producers on economic decisions of culling, feed allocation and treatment. Progress has been made for development and implementation of a data collection device that applies machine-learning techniques to characterize previously unobserved potential lameness factors of various sows. These collection units are designed to be portable and nonintrusive to farm workers. The unit has collected videos from over 500 sows at three farm entities — the Michigan State University Swine Farm for prototype development, and Barton Farms and Valley View Pork for prototype testing. A ceiling mounting fixture is being designed to allow the enclosed unit to be "popped" into place while collecting sow images and easily removed to be stored and reduce environmental exposures. The work is ongoing, and at the end of this project, a functional, automated and low-cost sow body composition biometrics system will be built — both hardware and software — to determine a status report of individualized animal production health.

Improving Michigan's ability to site livestock facilities

Jeff Andresen
Professor, MSU Department of Geography, Environment and Spatial Sciences
Michigan state climatologist

Odors from livestock production are the result of a complex set of circumstances, including location and size of the facility, species, feed storage and animal diets, type and size of manure storage, and odor control technologies. The movement and dispersion of odors are heavily dependent on meteorological factors such as wind speed and direction, as well as atmospheric stability. As livestock operations expand in Michigan due to favorable climate, population density and water resources, siting of facilities becomes critical. No livestock odor mitigation strategy exists that can replace proper siting. Having the tools to make proactive siting decisions is essential for both new and expanding facilities. The Generally Accepted Agricultural and Management Practices for Site Selection and Odor Control for New and Expanding Livestock Facilities (Siting GAAMP) has been used in Michigan since 2000. A key portion of the GAAMP since 2005 was the Michigan Odor From Feedlots-Setback Estimation Tool (MI OFFSET), which provided an estimated odor footprint around an odor source location of interest. However, the original version had limitations, including a single average odor footprint for the entire state based on a small number of climatic observing sites and only 9 years of data. Andresen's team updated and modernized the original

OFFSET scheme with a comprehensive new climatic dataset, providing detailed information that more accurately accounts for the influence of the surrounding Great Lakes on local wind and stability climatologies. Results of the new dataset were incorporated into a new web-based decision support tool, MI OFFSET 2018, which allows users to enter their specific location and odor emission information to obtain a location-specific odor footprint. Having this information to proactively identify areas that are best suited for livestock production is essential for both new and expanding facilities, and should support the growth of the Michigan livestock industry and its contribution to the state's economy.

For a list of 2018 funded projects, visit **maaa.msu.edu**

Legume impact on animal and forage production, enteric methane and nitrous oxide emissions in Midwest grazing systems

Jason Rowntree
Associate professor, MSU Department of Animal Science
Forages and grazing educator, MSU Extension

Although U.S. agriculture only comprises 9 percent of domestic greenhouse gas emissions, the production of beef cattle is considered a large emitter and therefore a key driver of climate change. New technologies and equipment allow for scientists to measure methane emissions while cattle remain on pasture. Known as Gas Quantification Systems, this equipment can be placed in the pasture and monitor emissions on up to 25 head of cattle daily. The data can be transmitted wirelessly to an online database for real-time assessment. Michigan State University is one of a few global universities using this technology. Rowntree and his team's primary goal is to examine the impact of two legume-containing forage livestock systems, and assess their subsequent greenhouse gas emissions with the goal of identifying management tools that lower the overall beef cattle carbon footprint.

Year 1 consisted of 104 days of grazing. There were no differences in forage productivity and animal performance between the two systems. In terms of forage growth, both treatments followed a similar pattern with production peaking in late June, followed by a significant decline by the end of July and beginning of August. In Year 1 of the two-year trial, Rowntree identified 20 percent lower enteric methane emission in cattle grazing a complex legume forage mixture versus a simple system composed of alfalfa grass. The results suggest that forage system management has the potential to considerably lower the carbon footprint of grazing cattle and increase environmental sustainability of beef production.

Optimizing nutritional management of sheep to improve reproductive outcomes in accelerated production systems

Richard Ehrhardt
Small ruminant specialist, MSU Extension

The seasonal supply of lamb and low flock productivity are primary barriers to growth of the North American lamb industry. Accelerated production overcomes both of these barriers by creating a consistent, year-round supply of lamb and by increasing productivity and production efficiency by decreasing the birth interval of an individual ewe from 12 to approximately 8 months. Ehrhardt and others have demonstrated that accelerated production can increase productivity two to three times the national average. A primary barrier to adoption of accelerated production is poor conception and litter size from ewes mated mid-winter to mid-summer. In Ehrhardt's preliminary work, he has shown that nutritional management of ewes during the pre-conception period in the spring can have a huge impact on reproductive outcomes. This project is investigating this further by extending the period of pre-conception nutritional management back into lactation of the previous production cycle. Ehrhardt is also extending the study to evaluate the impact of pre-conception nutritional management on reproductive outcomes in both spring and fall breeding periods. The initial phase of the study involved the enrollment of 125 ewes in early lactation during February 2018. These ewes were assigned to one of five treatments with random allocation of ewes to treatment that were stratified according to breed, parity and body condition score. These ewes were weighed, and blood samples were taken as often as twice per week over the entire study period. All ewes were subjected to routine — often weekly — assessments of pregnancy status via real-time ultrasound scanning from day 18 to term. The pregnancy outcomes of the first phase of the study revealed that the nutritional treatments employed impacted both lambing percentage and conception rate, suggesting feeding strategies may further enhance lamb production and profitability in accelerated systems.

Monitoring cow performance during milking to evaluate and improve worker training, cow udder health and milk quality

Stan Moore
Dairy educator, MSU Extension

On dairy farms, milking cows is obviously a critical task. It's performed two to four times daily and requires training. Employee training programs on milking procedures have been important in standardizing the procedures used on many farms. If not followed, this can result in lost revenue. This project sought to address training around two known problems that are prevalent on dairy farms: bimodal milking and over-milking. Bimodal milking occurs when cows are not properly stimulated during the pre-milk preparation or when the lag time between stimulation and attachment of the milking unit is insufficient for milk letdown to occur before the unit is applied to the teats. Over-milking occurs when milking is finished for each teat, but the unit stays on because of improper adjustment of the automatic takeoffs that stop the vacuum and remove the unit, or when employees override the automatic takeoff units.

Moore and the team worked with Michigan dairy operations to:

- Assess their current milk protocols, employee compliance and milking performance using VaDia vacuum recorders during milking.
- Provide input on participating farms' milking protocols.
- Work with owners and managers to provide suggestions on employee training to improve protocol compliance and milking performance.
- Re-assess milking after changes were made based on recommendations.

Twenty-six dairy herds from across Michigan were included in the project, with the support of interns and educators working in pairs to provide support to eight to nine farms each. Farms ranged in size from 105 cows to 3,500 cows, with a total of over 19,000 cows. Herds were visited at least three times each during the project. Participation by farms was voluntary and at no cost to the project. Three MSU Extension undergraduate student interns were employed to work with MSU Extension dairy educators in three areas of the state: northern lower, Thumb area and south central, and central. Results from initial visits and analysis of milking performance data reinforced that over-milking and bimodal milking are issues on Michigan dairy farms. These results were shared directly with local Michigan farms to improve worker training and efficiency of dairy operations.