

# UT PARLOR

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## New Research at the University of Tennessee Focused on Milk Quality and Mastitis

Producing high-quality milk in the Southeast has its challenges, and efforts to improve the process are being supported by funds from the U.S. Department of Agriculture. Before improvements can be made to overall milk quality in the Southeast, roadblocks need to be identified as well as what works and what doesn't; tools to help make informed decisions need to be developed; and current and future industry members need to be educated. The USDA National Institute of Food and Agriculture has awarded the university \$3 million through a competitive grants program. These funds will provide support to establish the Southeast Quality Milk Initiative. This five-year project is led by the University of Tennessee, which partnered with the University of Kentucky, Virginia Tech, University of Mississippi, University of Georgia and University of Florida.

To accomplish the ultimate goal of improving the sustainability of the dairy industry in the Southeast, the project has four key objectives. The first objective seeks to understand the attitudes that lead to the adoption (or not) of practices known to control mastitis. This understanding will help identify the types of interventions and resources that need to be generated. The second objective will focus on identifying what different owners do to best manage mastitis in the Southeast. These strategies will be shared with other owners to help them improve milk quality across the region. The third objective involves the tools — providing the paper and electronic resources to make informed decisions about on-farm practices. The fourth objective deals with training and education.

This project is geared not only toward farmers and individuals on their farms, but also toward anyone who can make up the support network, such as Extension agents, cooperative employees and food animal veterinarians. Just as

exciting are the internship opportunities for undergraduate students to spark their interest and expand their knowledge so they can be productive members of the dairy industry.

Researchers will be contacting you through surveys, phone calls and on-farm visits to solicit your help, time and cooperation in providing assistance with milk quality across the Southeast. If you would like to know more, please feel free to contact Peter Krawczel (865-974-8941; [pkrawcze@utk.edu](mailto:pkrawcze@utk.edu)) or Gina Pighetti (865-974-7225; [pighetti@utk.edu](mailto:pighetti@utk.edu)) in the Department of Animal Science.

SQMI Team Members:

University of Tennessee: Steve Oliver, Mark Fly, Gina Pighetti, Raul Almeida and Peter Krawczel

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— *Gina M Pighetti, Steve Oliver, Raul Almeida and Peter Krawczel ([pkrawcze@utk.edu](mailto:pkrawcze@utk.edu))*

## Play Behavior in Calves

Play behavior is an often overlooked but important indicator of health and well-being in dairy calves. It is considered a positive indicator because calves are usually only motivated to play when their essential needs are met. Observing play behavior on the farm is an easy and inexpensive way for producers to determine the suitability of the animal's

environment and the physical and emotional state of the animal. Using play to evaluate the environment and welfare of young animals, such as dairy calves, is particularly useful because juvenile animals are highly motivated to play.

Play behavior can change with management strategy, as reported in a study performed at the University of British Columbia. The findings showed that calves fed 1.6 gallons of milk per day played less than calves fed 3.2 gallons of milk per day. These results suggest that calves will play more when provided a higher plane of nutrition. Therefore, producers may use observation of play behavior to help determine if calves are consuming enough nutrients under the current management system. Space allowance also can affect play behavior. A study performed in 2000 at the Royal Veterinary and Agricultural University in Denmark found that 5-week-old calves housed in group pens that allowed 3 or 4 m<sup>2</sup> of space per calf played more than calves housed in pens only allowing 1.5 or 2.2 m<sup>2</sup> of space per calf.

Play behavior also can be used to evaluate calves' response to painful procedures as well as the efficacy of various pain abatement techniques. For example, the authors of a study conducted in 2013 at the University of California, Davis, used play behavior to determine the effects of disbudding on calves given various pain relief treatments, which were either disbudded or "sham" disbudded. Calves either received no pain relief treatment, local anesthetic only, or local anesthetic and meloxicam. Sham disbudded calves spent more time playing than disbudded calves; however, calves in the sham group that received local anesthetic played less than sham calves. Sham calves that received local anesthetic and meloxicam did not show a reduction in play behavior, indicating that the injection of local anesthetic prior to disbudding is painful for calves. Those calves disbudded with no pain control spent less time playing than any other group of calves.

The expression of play behavior may help animals cope effectively with novel or stressful aspects of confinement. A 2001 review article published by authors at the Research Institute of Animal Production in Prague stated that play behavior can help prepare animals for new experiences and help them avoid overreaction to novel or stressful events. Play allows animals to "practice" facing surprising or confusing circumstances, such as being knocked over or faced with novel objects without any real danger. In dairy cattle, play may help animals cope more easily with new experiences, such as entering the milking parlor or eating through headlocks.

Play behavior can be considered an important part of the time budget of young calves, as it can help prepare them for facing new circumstances later in life. Observing play behavior in calves can help producers evaluate the quality of facilities and calf management practices because play will not be expressed if the calves' most basic needs, such as the need for space and nutrition, are not met. It also can be used to determine the efficacy of pain abatement techniques after painful procedures such as disbudding.

– **Christa Kurman** ([ckurman@utk.edu](mailto:ckurman@utk.edu))



*Weaned Jersey calf on pasture at DREC.*

For further reading, refer to the following:

- Jensen, M.B., and R. Kyhn. 2000. Play behaviour in group-housed dairy calves: The effect of space allowance. *Appl. Anim. Behav. Sci.* 67:35-46.
- Jensen, M.B., K.S. Vestergaard, and C.C. Krohn. 1998. Play behaviour in dairy calves kept in pens: The effect of social contact and space allowance. *Appl. Anim. Behav. Sci.* 56:97-108.
- Krachun, C., J. Rushen, and A.M. de Passillé. 2010. Play behaviour in dairy calves is reduced by weaning and by a low energy intake. *Appl. Anim. Behav. Sci.* 122:71-76.
- Mintline, E.M., M. Stewart, A.R. Rogers, N.R. Cox, G.A. Verkerk, J.M. Stookey, J.R. Webster, and C.B. Tucker. 2013. Play behavior as an indicator of animal welfare: Disbudding in dairy calves. *Appl. Anim. Behav. Sci.* 144:22-30.

Spinka, M., R.C. Newberry, and M. Bekoff. 2001. Mammalian play: Training for the unexpected. *Q. Rev. Biol.* 76:141-168.

Stull, C., and J. Reynolds. 2008. Calf welfare. *Vet. Clin. North Am. Food Anim. Pract.* 24:191-203.

## Heifers Quickly Adapt to Pasture Housing in First Lactation

According to the last U.S. Department of Agriculture's survey of dairy management practices, roughly 30 percent of small- (<100 cows) or medium-sized (100 to 499 cows) dairies use a mixture of confinement and pasture-based housing for their lactating herds. The combined use of two different housing types can be problematic because environmental factors can influence a cow's behavior and productivity. For cows on pasture, factors such as management of pasture, forage type and quality, and supplementation strategy are all known to affect the grazing behavior of those cows. With continued high feed costs driving interest in lower input dairy systems, understanding how cows adapt to the introduction of pasture and how previous management can influence this adaptation are critical points to consider.

A team of dairy scientists from the University of Wisconsin recently published a study in the *Journal of Dairy Science* focused on 1) evaluating how dairy cows adapted to pasture housing, 2) the influence of previous experience, and 3) how cows with different prior experience with grazing behave relative to one another. These research objectives were tested with four different treatment groups of cows: those 1) housed on pasture throughout development; 2) housed on pasture in year one then confinement in year two; 3) housed in confinement in year one, then on pasture in year two; and 4) housed in confinement throughout development. All heifers were lactating in the third year of the study. They were managed using intensive grazing with an average of eight days on each paddock, which contained an average of 3,700 lbs/ha of forage. Pastures consisted of a mix of ryegrass, tail fescue, meadow fescue and white clover. The project focused on the behavior of these cows when on pasture and their productivity during the grazing period of year three.

In year one, the main goal of the study was to expose half of the enrolled heifers to pasture housing. Heifers in the two pastured treatments spent a total of 41 days grazing.

During this time, they gained approximately 62 pounds, or 1.5 pounds per day. The total weight gain was not different from those heifers housed in confinement during this time.

In year two, a comparison of the previous experience could be made between groups. Heifers that grazed in year one spent more time grazing the first day they were returned to pasture, relative to heifers housed in confinement in year one. This finding was the only difference in grazing behavior observed and was driven by the reluctance to graze demonstrated by the heifers that were confined previously. Additionally, the time spent lying while housed on pasture gradually increased. The distance traveled also differed between heifers previously housed on pasture (3.4 miles) and those housed in confinement (2.2 miles) on the first day. Again, this result was likely due to the greater amount of grazing done by the experienced heifers. This difference was limited to the first day on pasture, and the distance traveled gradually decreased to approximately 1 mile per day. Finally, during the first five days on pasture, the experienced heifers utilized a greater amount of the available space within the paddock, whereas the inexperienced heifers spent more time closer to the entrance to the paddock.

In year three, the heifers, now in the first lactation, responded similarly to year two when reintroduced, or introduced, to pasture. The heifers that had grazed for parts of years one and two spent the most amount of time grazing, whereas those that were housed in confinement only in years one and two spent the least amount of time grazing. Again, the heifers that had grazed in years one and two explored the greatest amount of the paddock on day one. Heifers that had only grazed in year one took an additional day to begin to explore a larger portion of the available paddock. The heifers with no previous experience with grazing did not explore beyond the area around the gate until their fourth day on pasture. After day four,



*Lactating Jersey cows enjoying spring pasture at DREC.*

the heifers explored a similar amount of the overall paddock regardless of previous experience. Milk yields were somewhat similar with the heifers with the most recent experience on pasture producing 72 pounds of milk relative to the 63 pounds of milk produced by heifers that did not graze during year two. Milk yields decreased during the grazing period among all treatments, but differences among the treatments persisted for the initial four days on pasture. There were no differences among the treatments in the average milk composition throughout the grazing period.

The results of this study suggest that previous experience does provide a beneficial effect on behavior and milk yields when heifers are turned out for grazing. However, these differences are short-lived. Typically, after four days on pasture, there were no differences in behavior or in subsequent productivity among the heifers with varying degrees of experience or timing of exposure. Even during their first lactation, heifers readily adapted to pasture, which means that this housing/feeding strategy could be incorporated easily into an overall management plan to reduce inputs.

– *Peter Krawczel (pkrawcze@utk.edu)*

For further reading, please refer to the following:

Lopes, F., W. Coblenz, P.C. Hoffman, and D.K. Combs. 2013. Assessment of heifer grazing experience on short-term adaptation to pasture and performance as lactating cows. *J. Dairy Sci.* 96:3138-3152.

### **The Benefits of “Robbing the Cradle”: Housing Heifers and Mature Cows Together**

Heifers are frequently housed in a mixed lactating herd with mature cows, which often causes them to be timid and subordinate to more dominant, experienced cows. Often, herds are too small, cow flow too difficult, or resources too limited to justify separating the herd into individual groups. This situation can create tension and aggressive behavior among more dominant cows, making resources more difficult to access and imposing a negative impact on heifer welfare and performance. When a first lactation group is not feasible, it is important to consider ways to make the transition into the herd less stressful, as introduction into the milking parlor and lactation itself are stressful enough.

One potential management strategy to reduce stress is to house heifers with dry cows before calving. In essence, mature cows are “robbing the cradle” by being housed with

heifers, allowing heifers to form relationships and create experiences with older cows. These experiences may reduce stress associated with regrouping and interacting with more dominant cows. Sowerby and Polan (1978) reported fewer negative impacts on milk production when dairy cows had prior experience with regrouping. This suggests a benefit to being housed with new animals before the onset of lactation.

A research group at the Agri-Food and Biosciences Institute in the United Kingdom, in collaboration with the School of Biological Science in the United Kingdom, conducted a research study examining the effects of housing heifers with dry cows before calving. Researchers aimed to study production and welfare-related performance post-calving when heifers were subsequently housed with mature cows. The study used a total of 20 Holstein heifers. They were divided into two treatments — mixed housing with mature dry cows or unmixed housing with other heifers. After calving, heifers transitioned to one of four lactating groups. Researchers observed animal behavior, including activity (displaced other cow by butting or shouldering, walking, feeding, drinking, ruminating or grooming), location (freestall or alley) and received behaviors (displaced by other animal by butting or shouldering). Standing and lying behavior was assessed using a data logger and observation. Blood samples were taken to assess cortisol concentration, or level of stress. Researchers also collected milk yield, body condition score and weight.

Heifers in the mixed treatment group encountered fewer aggressive behaviors during the two hours after being introduced into the lactating group than heifers in the unmixed treatment group (1.8 vs. 9 butts/hour). Aggressive interactions potentially add to stress levels already experienced, including calving and calf removal, lactation, and being in a new environment. Therefore, it is important to reduce the level of unnecessary stress. Giving heifers experience with regrouping and older cows may allow them to adapt more quickly to being regrouped into the milking herd. This practice also may give heifers experience with aggression, allowing them to learn to avoid aggression by avoidance, increased locomotion and active withdrawal.

Heifers in the mixed group moved throughout the pen more, left the stalls more often, spent more time in the alley by the feed, and actually spent more time at the feed bunk when in the mixed treatment group compared to the unmixed treatment group. Moreover, mixed treatment heifers experienced less aggressive interactions with other cows



*Mature cows and heifers housed together during the dry period.*

after feeding and were more aggressive to other animals than unmixed treatment heifers. However, unmixed treatment cows encountered more aggression, causing cows to move throughout the pen less and stay in stalls. Stalls may offer a level of safety to escape from aggressive interactions but may prevent heifers from getting to the bunk often enough. Cows with experience interacting with older, more dominant cows may have more competitive experience, allowing them to get to the feed bunk more often.

Lying time for both groups was below five hours during the first 24 hours after being integrated into the lactating group. Similarly, cortisol secretion, milk production and body condition score did not differ between the mixed and unmixed groups. This finding implies that the experience gained by being grouped with dry cows before calving does not have a short-term impact physiologically. However, this practice does have a behavioral implication in that welfare was improved by reducing levels of aggression experienced by heifers upon introduction into the lactating group.

– **Randi Black** ([rblack12@utk.edu](mailto:rblack12@utk.edu))

For further reading or complete data, refer to the following:

Boyle, A.R., C.P. Ferris, and N.E. O’Connell. 2013. Does housing nulliparous dairy cows with multiparous animals prior to calving influence welfare- and production-related parameters after calving? *Appl. Anim. Behav. Sci.* 143(1):1-8.

Sowerby, M.E., and C.E. Polan. 1978. Milk production response to shifting cows between intraherd groups. *J. Dairy Sci.* 61(4):455-460.

## Predicting Ketosis During Early Lactation

Many producers must deal with ketotic cows, or hyperketonemia, shortly after calving because at that time cows begin a period of roughly 60 days when dry matter intake cannot keep up with energy demand. Body condition at the time of calving coupled with diet heavily influence cows’ susceptibility. Cows that begin calving with a moderately lower body condition score and are fed a proper close-up diet are less likely to develop ketosis during early lactation. Conversely, cows with excess body condition have an increased risk of developing ketosis. One method for detection of ketosis is measuring beta-hydroxybutyrate (BHBA), a ketone body in the blood. Most cows (75 percent) with levels greater than or equal to 1.2 mmol/L develop ketosis within seven days after calving.

Producers are concerned about this disease for a multitude of reasons, including treatment costs, premature culling and reduced milk production. Each of these concerns leads to a bigger concern — profit loss. Therefore, it is important for dairy producers to manage cows in a way that reduces the risk of ketosis and, when ketosis does occur, observe the predictive signs to catch the disease early.

A research group at the College of Veterinary Medicine at Cornell University, in collaboration with the University of Wisconsin, conducted a research study with the objective of determining the risk factors of a cow developing ketosis during the first three to 16 days in milk. A second objective was to determine the risk factors of a cow actually having ketosis at the first testing for BHBA, or three and five days in milk.

Two dairy farms in New York were enrolled from May-September 2010, and two dairy farms in Wisconsin were enrolled from June-August 2010. Beginning when cows were approximately 266 days in calf, cows were scored for body condition and locomotion twice weekly. Additionally, blood was collected for the analysis of nonesterified fatty acids (NEFA) twice weekly on the New York herds only. After calving, cows were tested for BHBA levels using the Precision Xtra meter from three to 16 days in milk. Cows were considered ketotic when BHBA levels were equal to or exceeded 1.2 mmol/L. Additional data collected from Dairy Comp 305 included previous days carried calf, calving ease, calf sex, twins, stillbirth and parity.

Researchers developed four statistical models to describe the risk of a cow developing ketosis. Model 1 examined the

risk of ketosis at any time between three to 16 days in milk for all New York and Wisconsin herds. Model 2 described the risk of ketosis at any time between three to 16 days in milk for only the New York herds, including NEFA levels. Model 3 studied the risk of cows developing ketosis at the first BHBA test for all New York and Wisconsin herds. The final model, model 4, examined the risk of ketosis at the time of the first BHBA test for only the New York herds, including NEFA levels.

The models used to predict risk at the time of the first BHBA test produced a greater level of accuracy, potentially implying that this time period, or the first three to seven days in milk, is the best predictor of ketosis in early lactation. Many factors influence ketosis risk, including herd management, parity, precalving NEFA concentration, precalving body condition score and calf sex. Farmers should focus on third or greater lactation cows, cows with a NEFA concentration greater than or equal to 0.30 mEq/L, cows with a body condition score greater than the herd mean, cows that have a difficult birthing, and cows that birth a male calf. These cows should be monitored carefully to detect ketosis early and to potentially prevent detrimental reductions in performance.

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For further reading or complete data, refer to the following:

McArt, J.A.A., D.V. Nydam, and G.R. Oetzel. 2013. Dry period and parturient predictors of early lactation hyperketonemia in dairy cattle. *J. Dairy Sci.* 96(1): 198-209.

## Highlights From the 47th Annual Congress of the ISAE

At the recent annual Congress of the International Society for Applied Ethology, which is the scientific society dedicated to the study of animal behavior, research was presented that applies to dairy farmers in Tennessee. A few of those interesting studies are summarized below.

***The effects of light and dark on lying behavior, sleep, IGF-1 and serotonin in dairy cows.*** (E. Ternman and others from Swedish University of Agricultural Sciences, University of Helsinki and Universitat Autònoma de Barcelona)

The objective of this study was to determine the effect of housing dairy cows in either continuous light or during a short day (four hours of light and 20 hours of darkness) on their behavior and physiology. Mid-lactation Swedish red dairy cows were used in this experiment. Behavioral and sleep data were collected using an accelerometer and a portable EEG device (which attached to the head and monitored brain activity). Physiology was assessed from hourly blood samples that were collected using a jugular catheter. Cows housed in continuous light engaged in more REM sleep on average than those housed during a short-day photo period (62 minutes per day compared to 40 minutes per day). This result was likely related to the increased standing times occurring during the nighttime hours of the day relative to the daytime hours for those cows housed in continuous light. However, both serotonin and IGF-1 were higher in cows housed during the shortened day, which suggests that over the long term, continuous light may have a detrimental effect on the ability of a dairy cow to maintain a biological rhythm. This research group is currently following up this study with an evaluation of how time spent sleeping changes over the course of a full lactation cycle.

***Does milk intake or activity soon after birth predict the future growth and health of calves?*** (M. Rabeyrin, J. Rushen and A. de Passille from Wageningen University and Agriculture and Agri-Food Canada)

The objective of this study was to determine if the future risk of disease for and growth rate of calves could be predicted from their behavior in the days following birth. Holstein heifers were housed individually and fed approximately 4 gallons of milk for five days after birth.

After five days, these calves were housed in groups of five to eight with a continued feeding of 4 gallons of milk per day plus unlimited access to hay and starter grain. The milk intakes of these calves from day two to day four (i.e., during the individual housing phase) varied greatly and ranged from approximately 0.5 gallons per day to close to the full 4 gallons per day. The milk intake during this period was associated with the average daily gain occurring from birth to 28 days of age. The risk of illness was predicted by the amount of milk intake occurring in the first five days; 83 percent of calves diagnosed with respiratory disease or scours consumed less than the median amount of milk. On the other hand, activity during the first five days was not associated with subsequent weight gain or illness. Overall, the results of this study suggest that 1) calves can readily consume a large amount of milk immediately after birth, 2) those calves that consume more milk are likely to grow more and stay healthier than their herdmates that consumed less milk, and 3) milk intake is a better predictor of future responses than activity.

***Do lying times of dairy cattle on tie-stall farms in Canada predict prevalence of lameness? (G. Charlton and others from Agriculture and Agri-Food Canada, Valacta Inc., Universite Laval, DairyCo. and University of Guelph)***

The objective of this study was to determine whether the prevalence of lameness on tie-stall farms could be determined using lying time. This approach has been implemented successfully on free-stall farms and would provide a benefit to tie-stall farms as commonly used locomotion scoring systems are not always practical.

One hundred tie-stall farms enrolled in the study, and for each, the lying time, lying bout frequency and lying bout duration were measured on 40 lactating cows. On these farms, lameness, determined by a standard locomotion scoring system, averaged 25 percent and ranged from zero to 56 percent. The prevalence of lameness decreased as the average lying time of a farm increased. Lameness also decreased as the percentage of cows spending more than 14 hours per day lying down increased. On the other hand, lameness increased as the difference between the duration of the shortest and longest lying bout durations increased. This finding suggests that the farm management practices that increased lying variability might also increase lameness.

Despite these promising results, the relationships between lameness and aspects of lying behavior were all relatively weak. Thus, other factors need to be considered to accurately predict the prevalence of lameness on tie-stall farms.

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