



Rumination Monitoring White Paper

Introduction to Rumination Monitoring

Summary

Rumination is a proven direct indicator of cow wellbeing and health. Dairy producers, veterinarians and nutritionists have long relied on cud chewing—the sights and sounds of rumination—as a key monitor of dairy cow health. Dairy cows ruminate 450 - 500 minutes per day, and a drop in rumination time is a clear sign that there is something impacting rumen function or animal wellbeing. Thus, rumination monitoring can provide an early window for diagnosis.

This document explains the science behind rumination and describes the advantages of rumination monitoring to modern dairy herd management. It reviews the capabilities of a new technology that enables dairy producers to utilize rumination for individual cow health monitoring and early detection of health issues.



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Overview

As herd size grows, producers do not have the same personal contact they used to enjoy with their herds. Therefore the modern dairy producer tends to rely on technology to replace the past intimate proximity.

Identification and periodic milk recording enable very efficient genetic improvement in the milk production of the dairy cow. Inline milk recording enables constant herd monitoring and identification of cows in need of attention within a larger population of cows. However, the problem with milk production as a sensor for wellbeing is that it is a symptom; and in the case of a production drop, it can be a result of a problem that began several days previously.

In contrast, rumination – which is a function of what the cow has eaten and how well she has been able to rest – provides a more sensitive and earlier indication of a cow's health and wellness. This makes rumination monitoring an ideal solution for evaluating multiple aspects of cow status.

Early indicator of disease, malnutrition and other issues

A change in rumination can serve as a very early indicator of early lactation metabolic issues, and as an early indicator for diseases, such as mastitis. Furthermore, the return of rumination to a normal pattern is an excellent sign of treatment success. As a significant number of cows in a modern dairy typically suffer from one of the metabolic calving diseases, and likewise, many cows suffer from mastitis (often of a recurring nature), the benefits of early detection – and early confirmation of treatment – are obvious.

In addition, nutritional changes can be monitored and managed through rumination averages of groups and whole herd rumination patterns. Rumination has been shown to change by ration components, the physical characteristics of the ration, and general management of the herd. Constant rumination monitoring and management based on rumination data can therefore optimize not only the individual cow lactation curve but also whole herd production.

Additional validation of standing heat

For any dairy farm, accurate identification of estrus cows is important. Similar to the way that activity monitoring improved on the efficiency and accuracy of visual observation, rumination monitoring paired with activity monitoring can provide a further boost for heat detection. As almost all cows in heat exhibit a corresponding drop in rumination, monitoring individual rumination can provide actionable validation of cows in heat.



The Role of Rumination

The rumination process

Rumination is an important part of the process by which cows (and indeed, all ruminants) digest food. It is stimulated by the presence of roughage in the upper part of the rumen. Once the cud is in the mouth, it is chewed thoroughly, which increases the surface area available for microbial degradation; then the solid matter is swallowed back into the rumen.

Thus, one of the primary purposes of rumination is to physically break down coarse material in order to assist in its transfer from the rumen. An additional function of rumination is to increase the production of saliva, which acts as a buffer to the acids produced during the microbial degradation of carbohydrates.

The “need” to ruminate

Studies have shown that although duration of rumination is primarily determined by ration size and quality (i.e. composition), chewing the cud is an innate behavioral need in cattle, regardless of the amount of food ingested.¹ This means that a cow needs to ruminate a certain amount each day as part of her natural routine, as well as for the more obvious reasons of good nutrition, health and milk production.² As with people, cows that are not able to act upon their natural behavioral needs can become frustrated; they may exhibit typical side-effect behaviors, such as tongue rolling or bar biting.

The importance of rest time

Rumination tends to follow a basic 24-hour rhythm. Normally, cows spend about one-third of a day (8-9 hours) ruminating,³ during which they should ideally be at rest – i.e. lying down. Therefore, most rumination is done at night, with a significant amount of rumination also taking place during the afternoon rest time.

Disruption or decrease in a cow’s rest time, which may be due, for example, to additional walking required to reach new housing, elevated activity around estrus, social agitation or other reasons, can result in a decrease in rumination. Therefore, monitoring both activity and rumination can provide a very accurate indication of a cow’s health, welfare and estrus status.

¹ Lindström, T., Redbo, I. Effect of Feeding Duration and Rumen Fill on Behavior in Dairy Cows, *Applied Animal Behaviour Science* 70, 83-97, 2000.

² Lindgren E. Validation of Rumination Measurement Equipment and the Role of Rumination in Dairy Cow Time Budgets. Thesis, Swedish University of Agricultural Sciences, 2009.

³ Welch, J.G. Rumination, Particle Size and Passage from the Rumen. *Journal of Animal Science* 54, 885-894, 1982.

Nutrition and rumination

Daily rumination time depends mostly on the quality and quantity of feed consumed. In general, cows ruminate for 25-80 minutes for every kilogram (approximately 11-36 minutes per pound) of roughage they eat.⁴ Studies have shown that high-producing cows tend to consume more dry matter, eat larger meals in less time, ruminate longer and drink more water compared to lower-producing cows.

Because cows can voluntarily control their rumination, they stop ruminating when disturbed. Other events and conditions, such as maternal anxiety, illness or pain, will result in decreased rumination. In line with this, rumination time noticeably drops during estrus, as well as just before and after calving. The following chart, Figure 1, shows how various events and conditions affected rumination.

Rumination as a reflection of welfare

A cow's welfare is affected by internal and external factors: internally – her nutritional status, any pain she may be experiencing, the presence of and her responses to viruses, bacteria and other immunological issues; externally – her ability to cope with the weather, other cows in her group, housing and other aspects of her environment.

Parameter	Dry Period		Calving	Heat	Trim	Heat Stress	Mastitis
	Dry	Close					
No. of cows or events	75	72	75	199	98	671	45
Change in rumination	-43	-66	-255	-75	-39	-20	-63
Margin of error	1.93	2.50	10.4	6.19	8.77	3.40	12.9

Figure 1. Rumination monitoring is a sensitive indicator of overall cow wellness, as shown by the changes in rumination time according to various events (in comparison with the standard lactation value of 478 minutes a day).⁵

⁴ Sjaastad, ØV. Hove, K., Sand, O. Physiology of Domestic Animals, pp. 507-527. Scandinavian Veterinary Press. Oslo, 2003.

⁵ SCR research

The Benefits of Rumination Monitoring

Good monitoring is essential to good business

To succeed in today's ever-tougher business climate, with larger herds to manage and a growing shortage of skilled employees, dairy farmers need new ways to increase their profitability and yield. This means they need to improve their cows' wellbeing and produce higher-quality milk.

Cow monitoring is essential to objectively measuring wellbeing and to maintaining and improving herd productivity. Traditionally, visual observation was the common method for cow monitoring. Farmers used to watch their cows for several hours a day to learn about their wellbeing and detect heat. However, the value of visual observation is limited because it is dependent on skill and experience, is not fully accurate, and does not allow analysis. It is impossible to maintain observation 24 hours a day – which means that a significant share of heats may be missed by visual observation.

Ideally, cow monitoring should include monitoring of rumination. However, as with visual observation for heat detection, visual observation of rumination is fairly limited, since rumination takes place off and on throughout the day, and most significantly at night. More importantly, because rumination routine is highly individual, rumination needs to be measured per cow, with each cow acting as the reference for herself. Visual observation does not allow farmers to follow rumination on such a granular level.

What electronic monitoring of rumination can reveal

Technology is already part of modern farming and is playing an increasing role as more advanced systems and tools become available. In recent years, one of the biggest areas of development has been in electronic cow monitoring.

As outlined earlier in this document, rumination has been shown to be an important indicator of cow welfare, health and estrus status. A drop in rumination is a clear indicator for health issues before clinical signs become apparent and before milk production is affected. Likewise, return to normal rumination provides early indication that the intervention, such as medical treatment or nutrition change, is successful. When rumination and activity are both measured, the combination of these two indicators provides a highly sensitive and precise indication of cow status.

Early detection can maintain higher levels of milk production by enabling treatment of potentially sick cows before production drops. Early detection reduces the cost of treatment and will likely increase treatment effectiveness.

Early detection can also assist in ensuring cows reach the highest possible peak in production. In order to achieve the highest possible peak within the shortest period of time, farmers must be able to identify fresh cow problems and treat them as early as possible.



Early detection can minimize the penalty of diseases. In a study comparing mastitis cases detected using activity and ruminant data, it was found that these cows recovered

quicker and their recovery was more complete compared to mastitis cases detected using the traditional alert based on milk loss and milk conductivity increase alone.

Effects of Mastitis Detection Methods on Milk Production

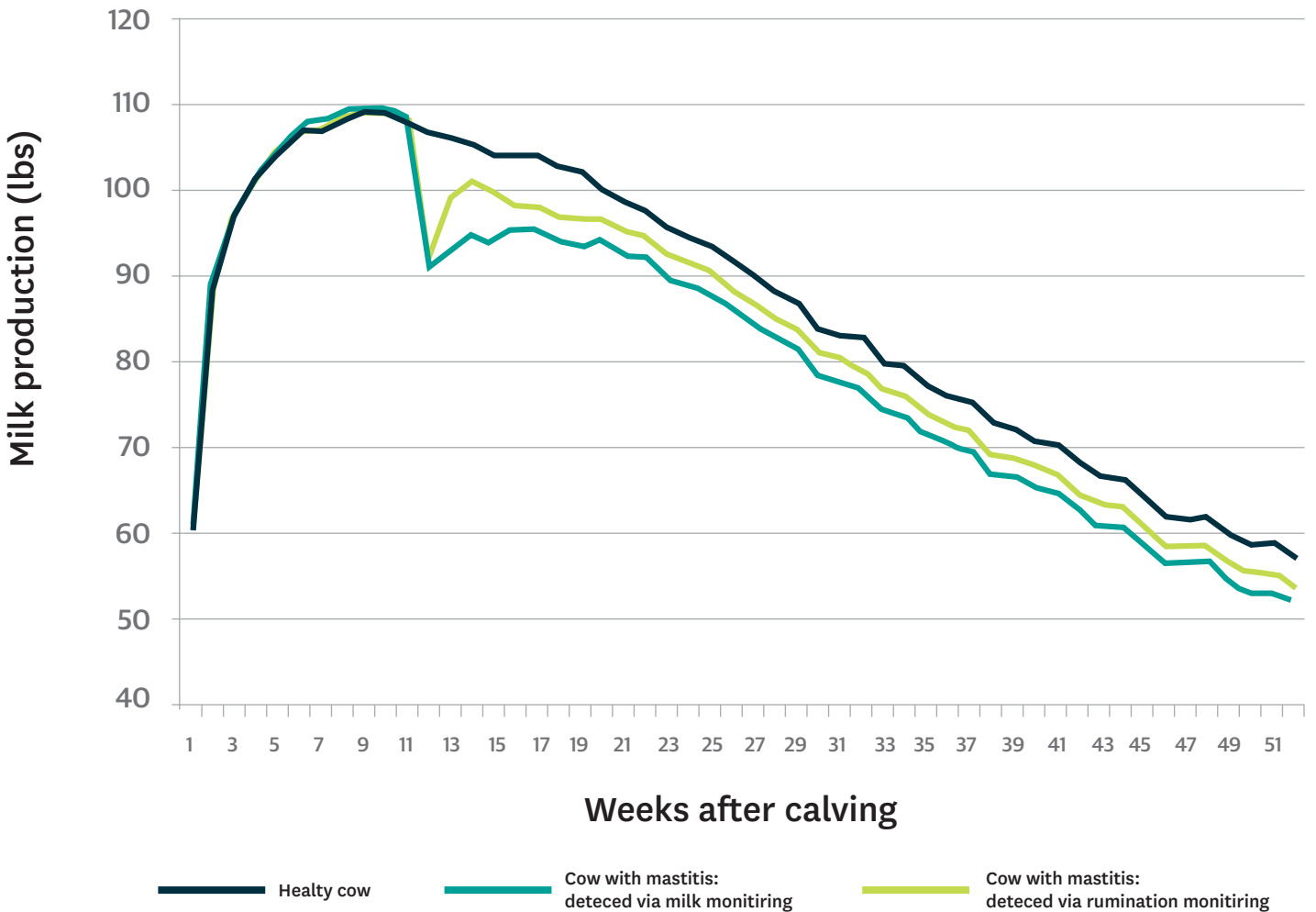


Figure 2. Lactation curves of healthy mature cows (blue line), cows with mastitis detected using alerts based on milk and milk conductivity (red line), and cows with mastitis detected using also activity and ruminant data (green line). All cows with mastitis were modeled as having mastitis at the median time point found in this study.⁶

⁶ SCR research

The first 60 days of lactation (after calving) are crucial. This is the time when milk production goes from zero to peak, which then determines how much milk the cow will produce in the months following those first 60 days. However, due to the demand for high energy utilization, the cows are under enormous stress, and during this time the cow is most susceptible to sickness. Detecting sickness early on makes it possible to treat the cow, without losing milk production on its way to peak.

With electronic monitoring of rumination, it is possible to monitor fresh cows by looking at their recovery rate (in terms of rumination minutes per day) and comparing it to the cow's "normal" rumination recovery rate. See Figure 3, below.

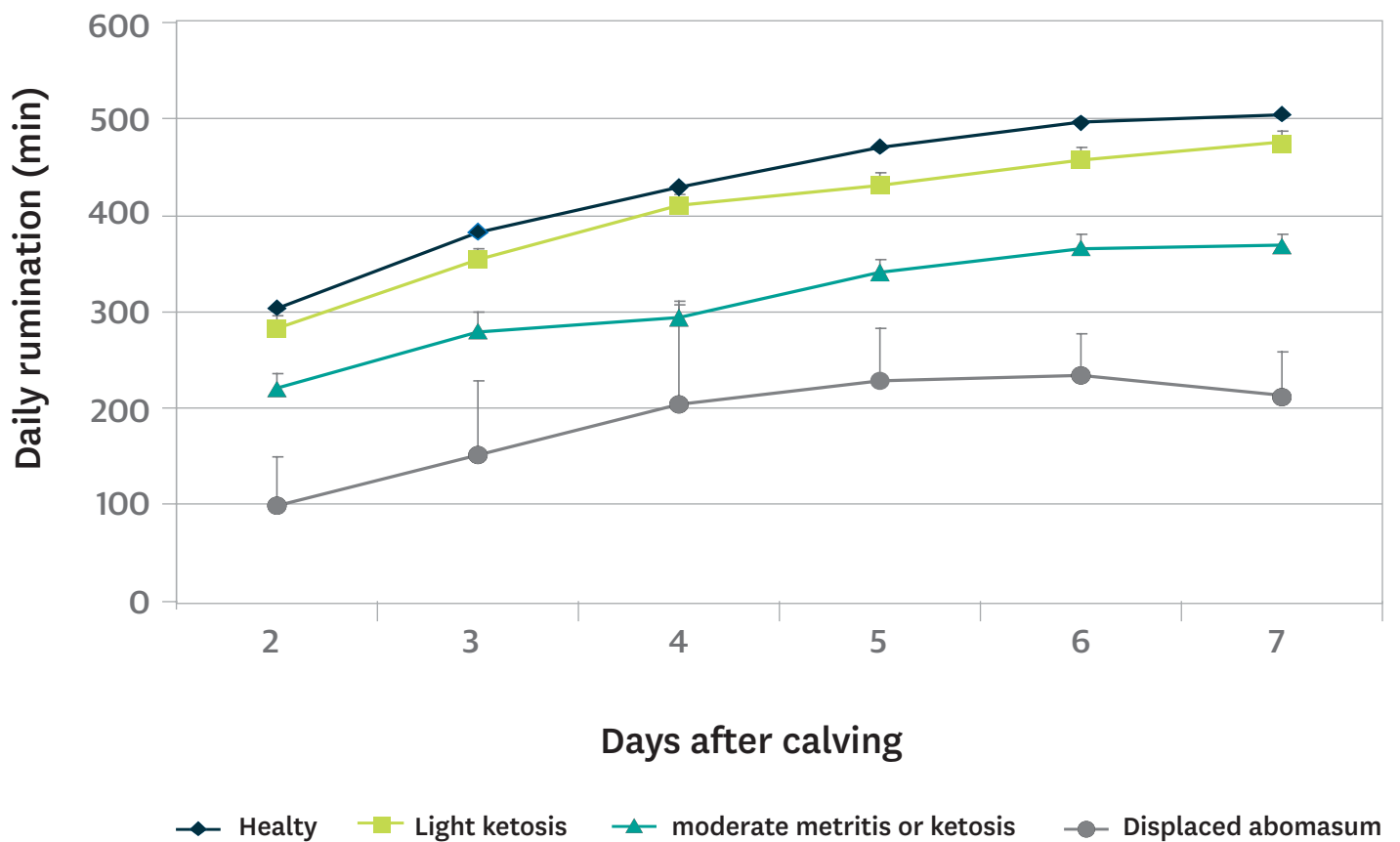


Figure 3. Daily rumination of fresh cows according to health condition.⁷

Figure 3 shows that rumination monitoring is an effective tool in prediction of post calving diseases and disorders. A healthy cow will ideally return to her target rumination within 6-7 days after calving (blue line in the graph). We found that cows with lower levels of rumination in the first week associated with post calving disorders will become acute 7-14 days later. By monitoring the cow's rumination in the immediate post-fresh period, it is possible to get an early indication of a possible health problem, and thus to treat it quickly and potentially lessen the amount of time until recovery. This has important ramifications for milk production over the entire lactation.

The SCR Heatime® HR System

The SCR Heatime® HR System, comprised of the HR tag, readers, and a terminal or PC-based software, constantly monitors individual cows' activity and rumination. The data is collected and analyzed by the system and presented in alerts and easy to understand lists and reports.

The SCR Heatime HR System has been proven, in scientific validation studies (for example, see Figure 4 below) and in ongoing daily use at dairy farms around the world, to provide accurate rumination information and actionable insight into cow health, wellbeing and reproductive status.

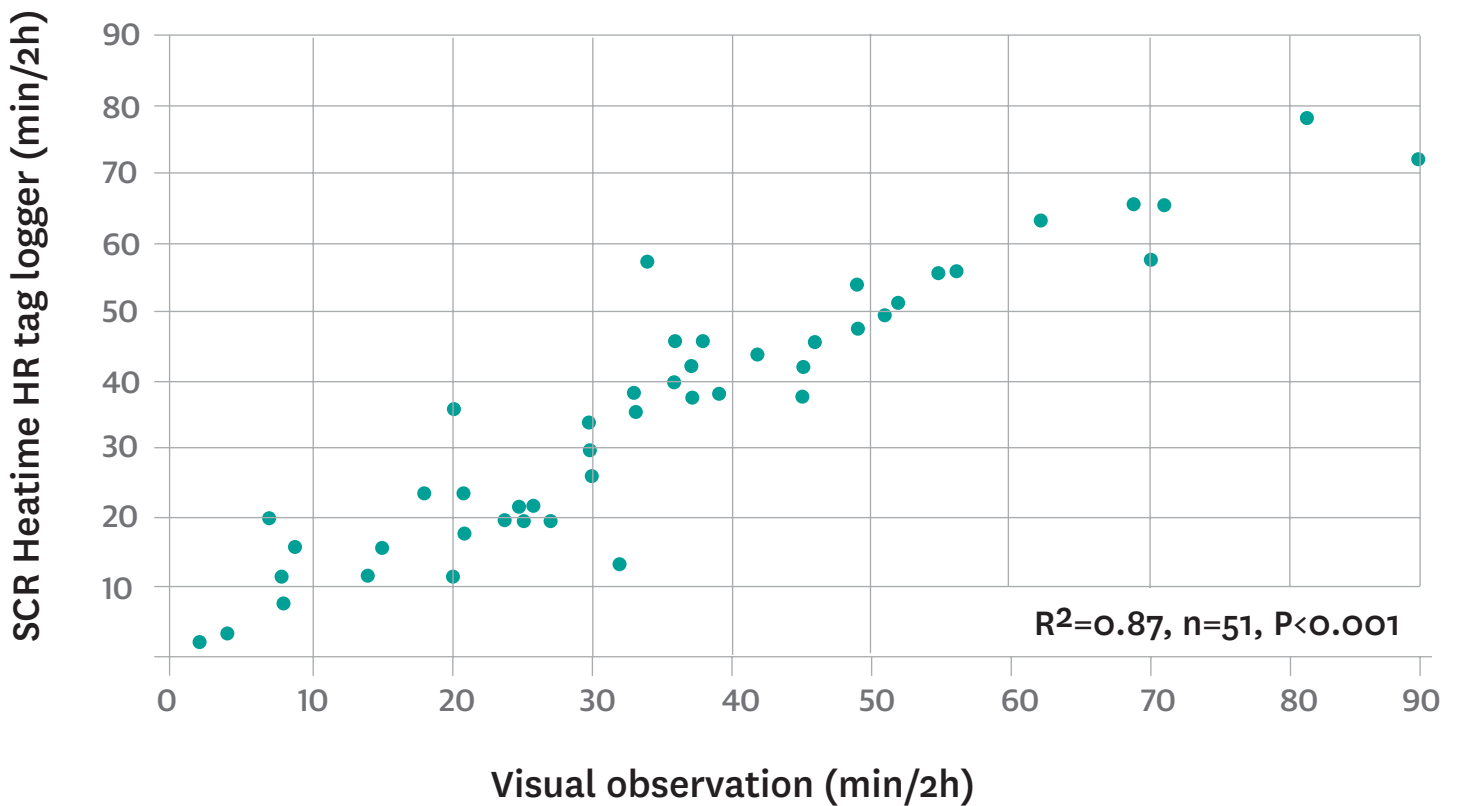


Figure 4. Comparison of logging by the SCR Heatime HR system with visual observation.⁸

An example of how the insight provided by the SCR Heatime HR System has been used for nutrition management is described on the following page.

⁸ Schirrmann, K. et al. «Technical Note: Validation of a System for Monitoring Rumination in Dairy Cows.» Journal of Dairy Science 92.12 (2009): 6052-6055.

Herd average daily rumination

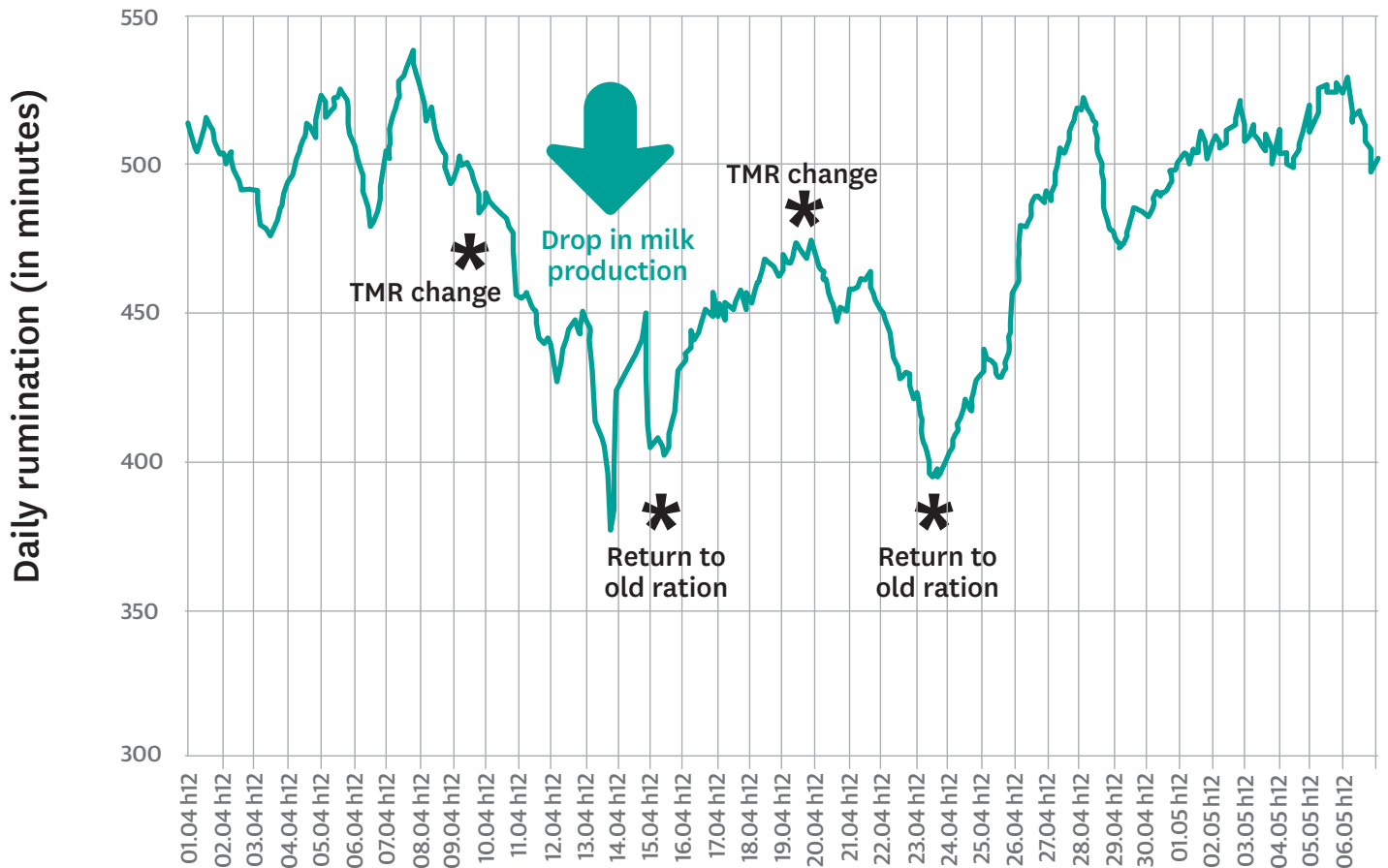


Figure 5. Actual average herd rumination levels, recorded at a dairy in Israel

Figure 5 provides a view of actual average herd rumination levels. A sudden drop in average rumination levels alerted the farmer to a possible problem. Four days later, milk production also began to decrease. Different sources of the problem were explored – until a soy component of the herd’s daily rations was removed from the diet. Average rumination times immediately increased. After a few days the component was returned to the herd’s diet and an immediate drop in average rumination times was again evident. At that time, the farmer decided to gradually return the ration to the herd’s diet, mixing it with other components while gradually increasing its ratio in the ration. Rumination levels returned to normal.

Dairy producer benefits of the SCR Heatime HR System:

- Precise heat detection and true reproduction management
- Eliminate tail painting and dramatically reduce usage of hormones
- Early detection of health issues
- Lactation curve management
- Postpartum recovery monitoring
- Assessment of cows’ short-term response to regrouping strategies
- Clear indication of reaction to ration and nutrition reformulation
- Insight into correlation between milk fat percentage and rumination rate

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