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Ketosis measurements in veterinary practice

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Abstract

The aim of this study is to evaluate the effectiveness of sequential measurements of fresh cows for ketosis. Two Dutch farms provided the data for nearly four consecutive years of testing all cows with the Precision Xtra test. There was no reduction of ketosis seen during this time. Lowering the energy level of the rations for the dry cows was effective on the B farm. There was a lower incidence of ketosis seen on the A farm during the grazing season. Testing of all fresh cows for ketosis was not useful for evaluating transition management due to frequent changes in this study.

Introduction

Intensive genetic selection throughout the years has resulted in dairy cows that are able to produce very high milk production. Good management practices have to be adopted by farmers to continue the genetic potential for a high milk production. The transition from prefresh to fresh cows especially needs good food management. This transition is a critical point for the cows due to the metabolic and nutritional changes. If this critical point is not managed well, there will be a bad adaption to the negative energy balance. Therefore, much research has been done to find good indicators for the quality of the transition management. It is necessary to initially focus on clinically sick animals, e.g. cases of milk fever, clinical ketosis and retained placenta.

In order to further improve the transition management, we need precise parameters to be able to monitor subclinical diseases. Firstly, the clinically sick animals are only the tip of the iceberg. Secondly, due to the monitoring of subclinical disease can also be obtained a much better understanding of the quality of the transition management. Therefore it is useful to measure subclinical ketosis in fresh cows, because it gives a clear image.
The level of β-hydroxybutyrate of cows shows how well cows have made the transition from pre-fresh to fresh cows.

Ketosis is a condition found in dairy cows, both clinical and subclinical. This disease has already been described in the fifties (Holmes, 1950). Ketosis is a condition that occurs when a cow after calving starts to give much milk and therefor falls into a negative energy balance. Subclinical ketosis is defined as an increase of the ketone bodies in the blood in the absence of clinical symptoms (Anderson, 1988). Recent studies show that in the Dutch herds an average of 46% of the cows test positive for ketosis between 7 and 21 days after calving(Berge & Vertenten, 2014.) Another study showed a much lower prevalence of 12%(Enjalbert et al, 2001). This is consistent with the findings of LeBlanc which signals that the incidence is estimated to be low, but turns out to be high to measure the systematic in the first three weeks after calving (Leblanc, 2014).
Subclinical ketosis is connected to many other problems that occur with fresh cows. First, there is a much higher chance of developing clinical ketosis but also displaced abomasum, retained placenta, metritis, lameness (Berge & Vertenten, 2014), reduced fertility, more (Walsh et al, 2007) and more severe (Kremer et al., 1993) mastitis and an increased chance of being removed from the herd. These are expenses that make ketosis quite costly (McArt et al 2012-9). Finally ketosis could provide a reduced milk production (Duffield et al, 2010), but here the relationship is ambivalent. Thus, a higher β-hycroxybutyrate-level for heifers is correlated with a higher milk production (Ospina et al, 2010)!
Sub-clinical ketosis may be due to individual cow-factors, or to operational factors. Because ketosis also has an effect on the performance of the cow, it is recommended to treat individual cases. With the advent of the keto-Test it is possible to determine sub-clinical ketosis among individual cows (Enjalbert et al, 2001). This test on the milk makes it possible to determine quickly whether or not a cow suffers from (sub) clinical ketosis. Usually, detection and treatment of ketosis is economically attractive , especially at high rates (McArt et al, 2014). Treatment lowers the risk of displaced abomasum and removal of the herd (McArt et al, 2012-5).

Increasingly, monitoring ketosis is used to evaluate the transition management of a farm (LeBlanc, 2010). Adjusting the transition management is a method to achieve better health and fertility of the herd. In this context it is important to reduce the prevalence of subclinical ketosis via the management. It is remarkable that subclinical ketosis occurs less on large companies (Berge & Vertenten, 2014). It is generally accepted that a high prevalence of ketosis is a herd problem. A possible measure is then referred to as the adjustment of the feed supply. There is even a possibility to relate the peak- incidence time in days to the underlying problem (Oetzel, 2004).
The keto-stick is at the company level or routinely used for the detection of individual cows and treat for (sub) clinical ketosis. It is an inexpensive and rapid test that is also easy to repeat. At some farms, this test is also routinely used. Unfortunately, this test is not suitable to assess the herd due to the test properties (Geishauser et al, 2000).
There is also research into diagnosing problem herds with subclinical ketosis in the milk check. This milk-control model is able to detect a problem herd with reasonable certainty (Van der Drift et al, 2012). It is only the question whether these results actually lead to a change in the management of such herds. Since there are also individual cows mentioned on the rash, it is likely that farmers will look at that individual cows and therefore not change their management practices.

Recent research by Ospina et al. (2010) on large farms that perform TMR provides cut-off values. This study found that a value higher or equal to 0 , 7mmol / L in 15% of the herd increase the incidence of clinical ketosis or displaced abomasum with 1,7%. In herds where more than 15 % of the cows scored greater than or equal to 0.6 mmol / L , there is a decrease in the pregnancy rate of 0.9 percent . For production, the cut-off value for heifers is 15 % equal to or higher than 0.6 mmol / L , this provides less than 288 kg milk. For cows , the cut-off value is 0.7 mmol / L , again at 15% of the herd. The production loss is much more serious: 593kg . This low cut-off values and the values found in this study indicate that there is still much room for improvement in the Dutch companies .

The routine measurement of ketone bodies provides much information about individual cows. However, if many individuals are tested, this can also provide valuable information about the management of the herd, especially of the feeding of the dry and fresh cows. This may be more profitable than what could be achieved only by the treatment of individual animals. E.g. production loss due to clinical ketosis could be predicted by examination of subclinical ketosis. So, while individual testing of cows is good, herd-level information of the quality of herd management would be better.
This could be achieved if we could examine the data of individual cows for evaluating the management of the herd.

The objective of this study is therefore to evaluate whether changes in routinely collected information on the prevalence of hyperketonemia in early lactating cows was followed by management adjustments with regard to feeding and whether these adjustments changed the prevalence of hyperketonemic cows.

Material and Methods

For this retrospective study, data from two farms were available. The first herd, (farm A) was a conventional herd with about a hundred calvings per year. The other herd was on a experimental farm. (Farm B). Of the experimental farm were completed rations per week known both of the dry cows as well the dairy cows. Therefore, the nutritional data of farm B is also included in the analysis. The data covers a time span of nearly four years. The measurements started a year earlier at farm A, but ended also earlier, due to the availability of data. Both farms were feeding a ration of grass silage and maize silage . This was made up to the norm with concentrates in a concentrate feeding computer. Cows were fed to feed requirements. In the grazing period, cows were pastured.

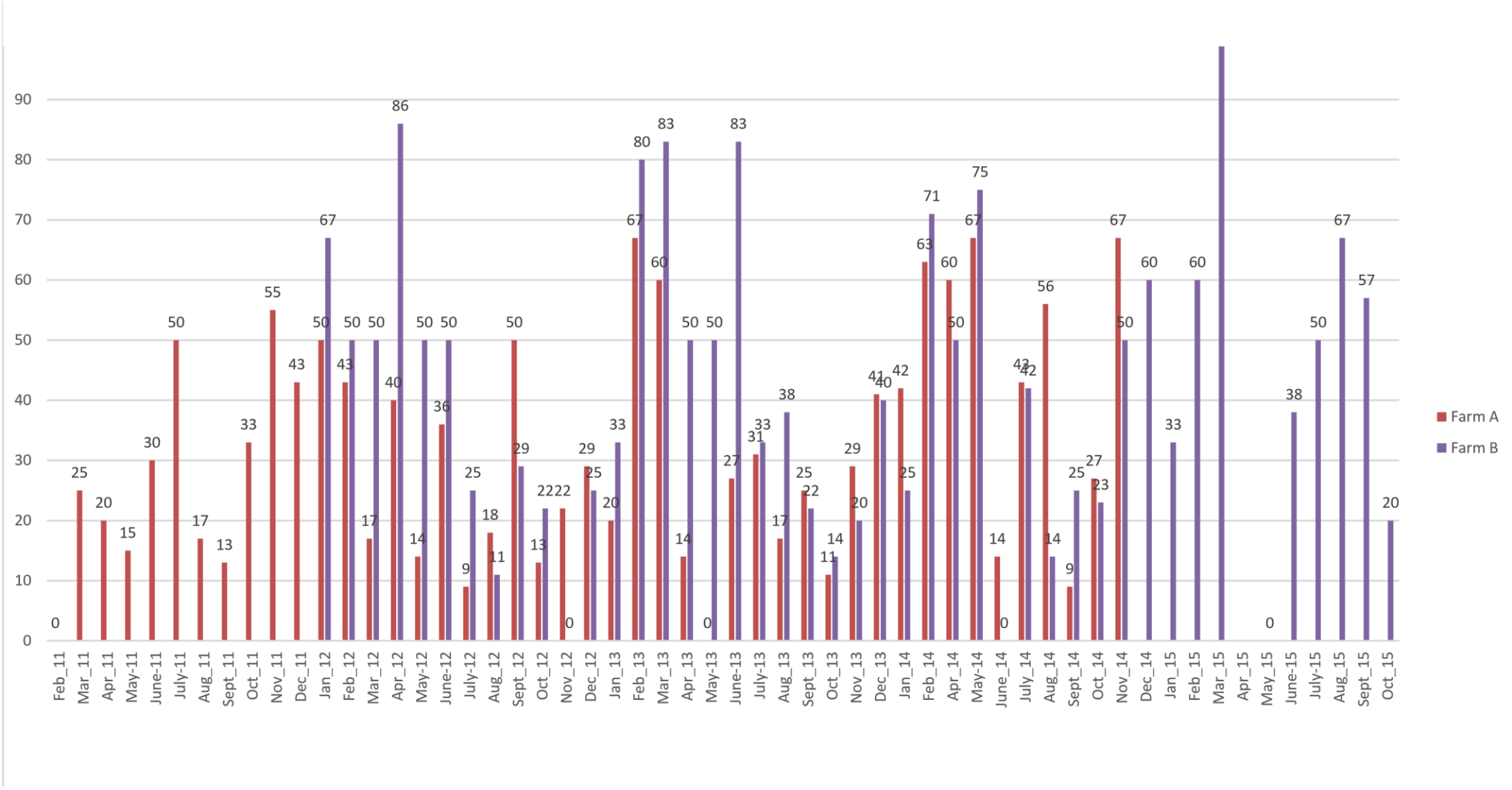
Individual cows from the two herds were tested for NEFA in their blood by a veterinarian on the farm or by the farmer himself. The test samples were taken by analyzing whole blood with the Precision Xtra test. In principle, each cow was tested , within one month after calving. Cows that were culled before the visit of the vet were not measured.

Cows were defined as healthy if they had a score of 1,1 mmol/ L BHBA or less. Cows were considered to have hyperketonemia if they scored 1,2 mmol/L BHBA or more. The calving dates of the cows was compared with the management information. Especially the feed management of dry cows and milking cows was considered, trying to connect changes in management with changes in the prevalence of ketosis in fresh cows. Therefore the changes in the management and the ketosis- measurements were displayed on a time line. Changes in prevalence were tested on significance by a chi-square test. Data of feed rations of milking and dry cows were examined and compared. This was done in far more detail at the B farm, due to a lack of those data on the A farm. From the rations, the last two weeks of 2014 and the first week of 2015 were excluded from examination due to unrealistic low values.

Results

Chart 1 shows the measured prevalence of subclinical ketosis per month. A total of 376 measurements were made on farm A. 120 of these measurements were ketosis positive. This gives a listing prevalence of 32%. On farm B 292 measurements were taken. Of these 115 were positive for ketosis . This provides a prevalence of 39% .

Chart 1. Percentage of ketosis (>1,1mmol) per month.



The incidence of ketosis was lower during the grazing season on farm A (from the start of grazing till 1 sept) than during the stall season (1 dec till start of the new season) (p = 0,02). On farm B, the incidence of ketosis was higher during the grazing season (april-1 sept) than during the stall season (1 okt- start of the new season) but this difference was not significant (p= 0,23).

The incidence of ketosis was higher in the first two quarters of the year compared to the last quarter on farm B (P= 0,000254 and 0,00057 respectively). On farm A the incidence of ketosis was higher in the first quarter compared with the second and the third quarter (P= 0,049 and 0,015 respectively).

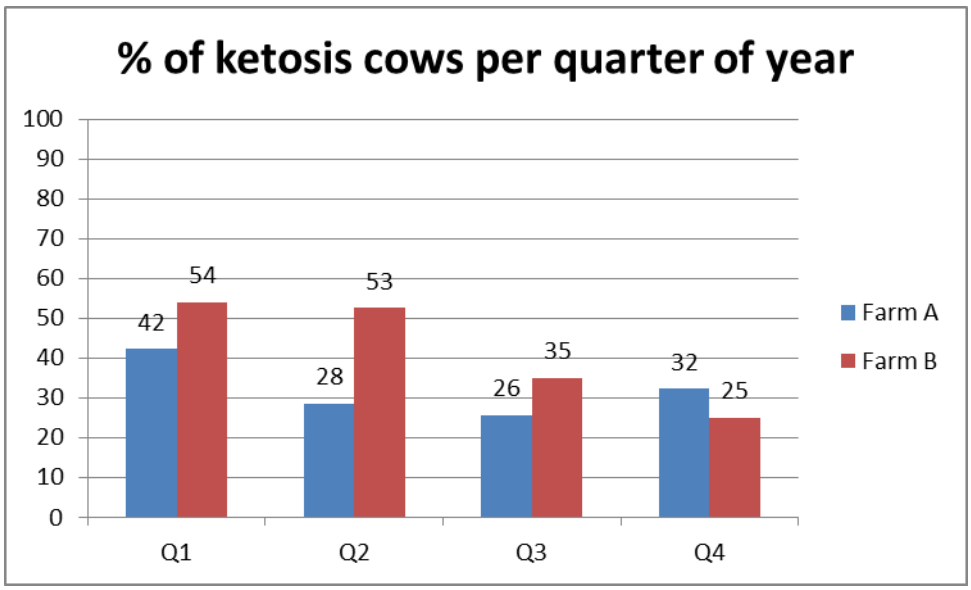


Chart 2. Prevalence of ketosis on both farms listed per quarter of year.

The farmers evaluated the herd especially about the last five or ten cows that calved most recently. If there was a high incidence of ketosis, they started looking at the forage of the dry cows. However, they did not know exactly how to manage the incidence of ketosis. Most time they re-evaluated the forage of the dry cows with their feeding advisor. Other alternatives were giving grazing to the dry cows during the grazing season. By the design of the experiment, it was not possible to evaluate grazing measures. However, on farm B action was taken to lower the energy level of the forage for the dry cows. This resulted in a notable decline during the conduct of energy - poor natural grass at farm B . This can be seen in the graph below. The low-energy dry cow ration was conducted from July 2012 to November 2012. During this period, 43 cows calved , of which eight had evidence of subclinical ketosis. Thus, the prevalence occurred during this period at 19% (P= 0,0026).

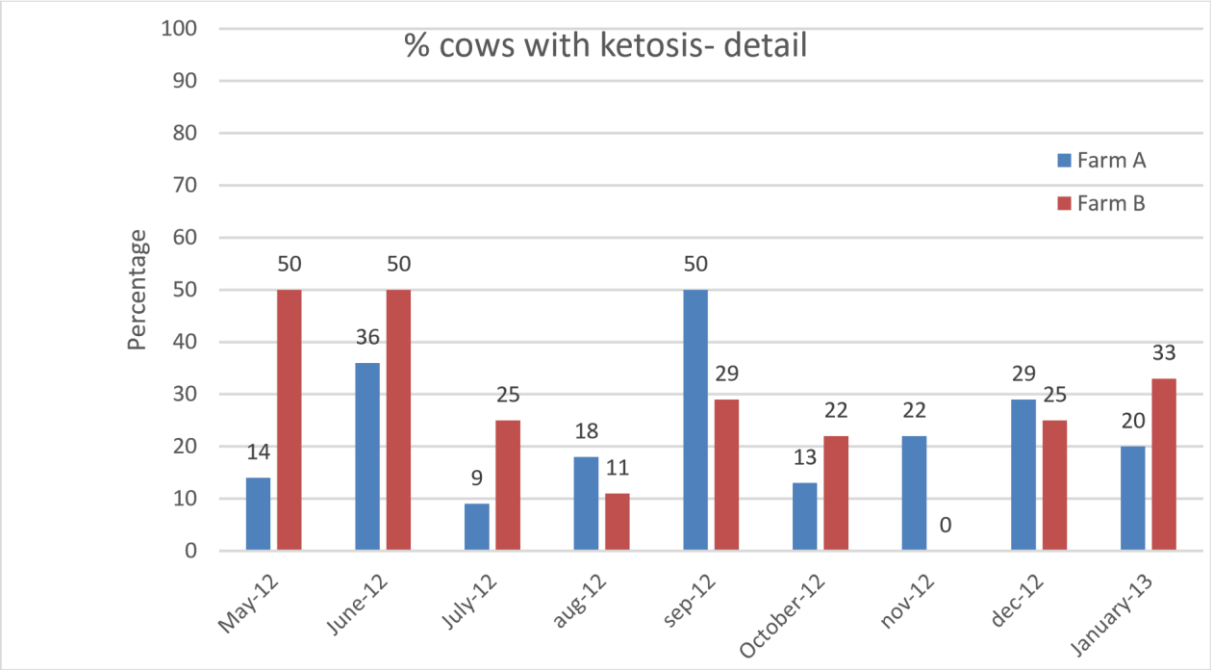


Chart 3. Prevalence of ketosis on the B farm decreased when they fed low- energy forage to the dry cows from July till November 2012.

In general, the herd level incidence of ketosis was not well- evaluated by the farmers. They did not know how many cows they had to engage in the review. For evaluation they relied on their veterinarian and for improvement they relied also on their feed consultant . On Farm A led an evaluation of the food consultant one time to further increase the energy level of the dry cow ration.

Tabel 1. Dispersion of energy and protein feeded to cows compared to 100% of requirements.

	Year	12	13	14	15
Dry cows	Energy %	73-141	88-143	80-147	89-150
	Protein %	87-156	88-149	92-154	101-169
Milking cows	Energy %	97-129	102-131	104-119	
	Protein %	94-122	94-123	99-116	

On farm B, the dispersion of the energy level for the dry cows was far greater than the dispersion for the milking cows. This could indicate that the over- and underfeeding of dry cows is more common than the over- or underfeeding of milking cows. Feeding of dry cows to requirements is a problem due to low numbers of dry cows and the limited availability of suitable forage for dry cows.

Discussion

The best method to assess subclinical ketosis at herd level is measurement of beta-hydroxy butyric acid in the blood. This is to establish or rule out a herd problem. Oetzel describes the following method. This method takes 12 blood samples from cows between day 5 and 50 wherein the content is determined to Beta-hydroxybutyric acid. He suggested 10% incidence as the limit beyond which there is a herd problem (Oetzel, 2004). For a sufficiently reliable diagnosis of the herd are sufficiently cows (12-15) required , wherein in fact not allowed to change the circumstances between the measurements . This is in some farms, especially grazing farms, very difficult , because of frequent ration changes, housing and grazing of cows and low number of calving cows. Even the availability of suitable forage could be a problem due to the low number of dry cows.
So, a problem that continues to exist in this study is that the evaluation of the transition needs a minimum of twelve measurements for reliable testing. Most times there was something changed during a term when twelve cows were evaluated. This was caused by frequent changes of the forage, about every three weeks, for the dry cows and frequent changes of food for the milking cows as well, which troubles a good rating of the transition. So, for a good evaluation we need 12- 15 cows that calve in a short time, and no changes in this time.

Results of this study show that there is much improvement possible. However, we found a lower incidence of ketosis during the grazing season on farm A. This may be caused by the good quality of pasture in the spring, and by providing a grazing at the dry cows in the summer.

We found a difference in the prevalence of ketosis between different quarters. This is partly consistent with the study of Berge and Vertenten (2014) . They found most of the increase in the second quarter . In this study we saw on farm A an increase in the first quarter and a tendency to increase in the last quarter . On farm B we saw an increase in both the first and the second quarter. The high prevalence in the first quarter may be explained by the fact that there was a quota system in those years. In the first quarter, the quota year is ending and farmers can then decide to lower concentrates.

Finally, both farms were achieving a lower incidence of ketosis than the Dutch average. So, the consciousness of ketosis could enable farmers to improve transition management, but we need more knowledge to lower herd- level incidence of ketosis. That there was no lowering of ketosis was maybe due to frequent changes of rations, about every 3 weeks, that complicated a good assessment of the transition management.

Because the farmers rely on the veterinarian and the feed consultant for good advice, it is important that they have sufficient knowledge to evaluate and improve the transition management. Ketosis measurements of fresh cows is a good tool as long as the results are properly evaluated and leads to effective measures

Conclusion

The measurement of ketones in blood of fresh cows can provide valuable information about the individual cow as well as on herd if it is repeatedly tested . Measuring with a Precision Xtra meter gives quite reliable results . It is, however, difficult to obtain reliable results in these Dutch circumstances that allow as to draw reasonable conclusions about the herd. We found a difference in the prevalence of ketosis between different quarters of the year. Lowering the energy-level of the ration for dry cows resulted in a significant decrease of hyperketonemic fresh cows. In this study, no lowering of ketosis was seen during the ketosis measurements but the farmers themselves were more aware of this invisible problem. However, feeding of dry cows to requirements seems to be a bottleneck in Dutch circumstances with low numbers of dry cows. Also the limited availability of suitable forage for dry cows is
a problem. Sequential ketosis measurements for herd evaluation is useful only if there can be done sufficient measurements without interim changes in transition management.

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