FACTSHEET

Negative energy balance, a focus on Ketosis

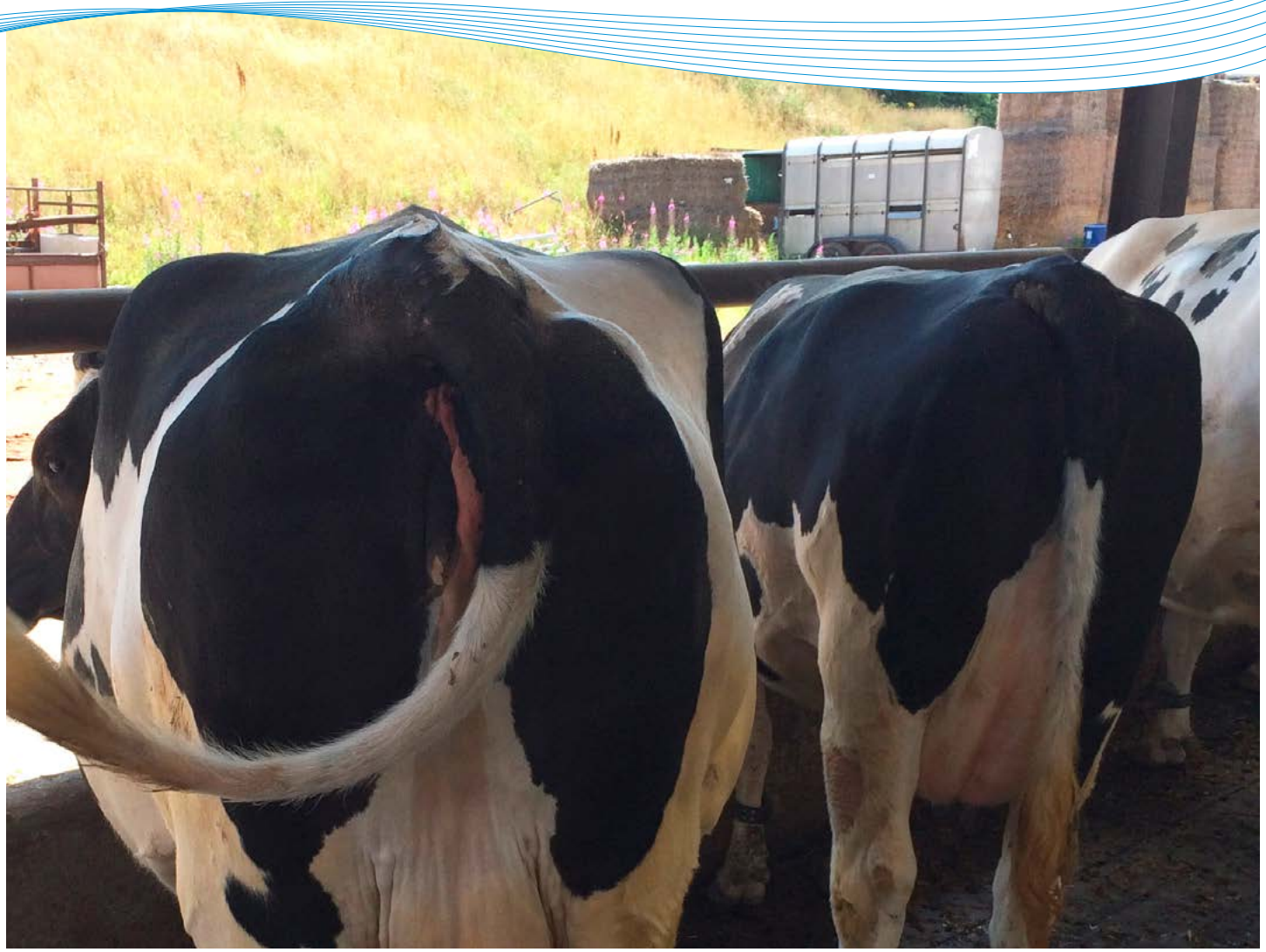

Figure 1. Over conditioned cows. Source: Dairy Veterinary Consultancy Ltd.

Fat mobilisation and ketosis

Nearly all dairy cattle experience a period of negative energy balance (NEB) around calving. This is due to a mismatch in their energy requirements at the onset of lactation: energy demands increase massively but dry matter intake is at its lowest (see Figure 2). When negative energy balance occurs, cows may experience ketosis.

Ketosis is defined as an elevation in blood, milk and urine ketones. Clinical ketosis is accompanied by visible signs. Subclinical ketosis occurs without clinical signs, but it is still detrimental to health and productivity. Ketosis is sometimes called acetonaemia.

What are ketones and how are they formed?

During the period of NEB around calving, the cow mobilises body fat reserves to generate energy as glucose in the liver. When the energy balance is highly negative, the liver is unable to break down fatty acids completely and produces ketone bodies, often simply called ketones (acetone, beta hydroxybutyrate – BHB and acetoacetate) instead.

These ketones can then be used by some tissues for energy, to conserve glucose. While ketone production is part of the cow's normal response to negative energy balance, if fat mobilisation is excessive or negative energy balance is too profound or lasts for too long, it can lead to subclinical or even clinical ketosis, with negative impacts on animal health and performance.

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Ketosis types

Type 1 ketosis occurs due to an undersupply of energy relative to demand. It can occur due to poor dry matter intake (i.e. sick animals) or low energy density of rations. It typically occurs 3–8 weeks post-calving as energy demand for milk production increases.

Type 2 ketosis happens when excessive fat mobilisation occurs due to over conditioned cows or poor dry matter intakes around calving. This is commonly observed when transition management is poor, i.e. where prolonged overfeeding and/or excess BCS prior to calving occurs. It typically develops in the first two weeks post-calving and is associated with fatty liver.

Fatty liver is a serious condition where too high a level of fatty acids is stored in the liver. This generally occurs when massive fat reserves are mobilised too fast for the liver to metabolise them properly.

How can you tell your cow has ketosis?

The clinical signs associated with ketosis are mild to moderate and generally non-specific. The cow can have moderate milk drop and reduced feed intake. Dung can be firm, and a 'pear-drop' smell in the breath may be noted.

Nervous ketosis is occasionally reported, where cows present with neurological signs, including disorientation, excessive licking and, occasionally, aggression.

Note that a clinical ketosis is the tip of the iceberg and it may mean that many more animals are affected by the subclinical form of the disease.

How to diagnose ketosis

There are several ways to check the presence of ketosis. The most accurate is by using cow side BHB meters: these instruments enable detection of BHB in a drop of blood. Subclinical ketosis is defined as BHB greater than 1.2 mmol/L without the presence of clinical signs. Other tests detect ketones in milk and urine but these will not provide a specific number, so the correct interpretation of the result is critical.

Welfare and economic impact

Ketosis is a gateway disease and both clinical and subclinical ketosis predispose cows to other conditions. Cows with subclinical ketosis have a greater risk of displaced abomasum, metritis and retained fetal membranes. They are also more likely to be culled in the first 60 days in milk. There are further costly side effects of ketosis including reduced milk yield, reduced conception rate and increased rate of ovarian cysts, all contributing to a prolonged calving interval and low overall fertility.

The true costs of ketosis must include the costs of both clinical and subclinical disease and account for both the direct and indirect costs associated with the disease A case of ketosis costs approximately £200.

Table 1. The direct and indirect costs of Ketosis

Direct costs	Indirect costs
Treatment	Cost of increase in RFM, metritis, LDA
Lost milk yield	Cost of increase in culling rate
Herdsman time	Cost of increased calving interval

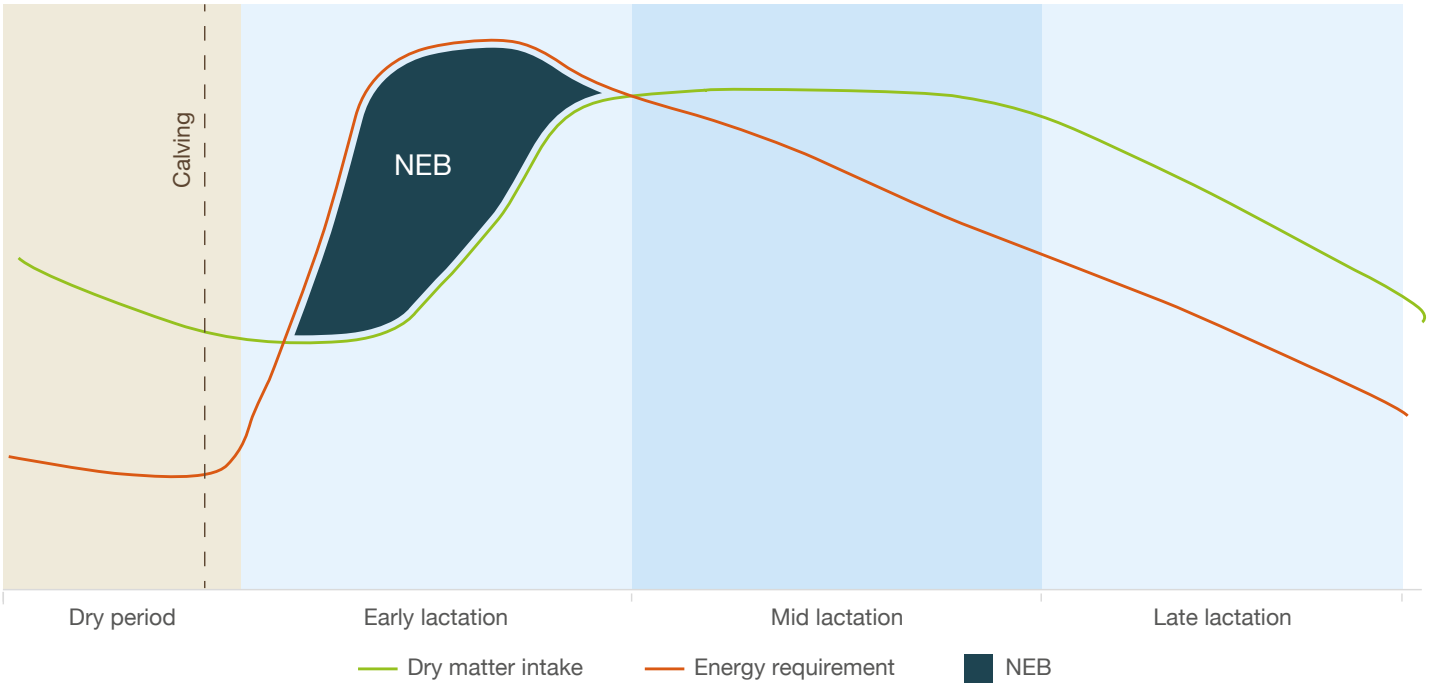

Figure 2. Energy balance and dry matter intake curves

Epidemiology

In the UK, an average of 30% of dairy cows undergo a period of subclinical ketosis and about 3% undergo clinical ketosis in the first month of lactation. There is wide variation in the number of cows affected by subclinical ketosis, with almost 60% of cows affected in some herds.

Treatment

- Propylene glycol – propionate from propylene glycol can be used by the cow to produce glucose. Administration of 300 ml daily can help reduce ketone concentrations. Care should be taken because overdose can be toxic to rumen microbes
- Further treatments may be necessary but should be discussed with your vet

Preventative strategies

- Body condition
  - Ensure cows are not overfat at drying off and that they do not gain condition during the dry period
  - If you have over conditioned, stale cows, consider a 'fat' group at the end of lactation to avoid further gains of body condition before drying off. Alternatively, dry fat cows off early and put them on a low-energy density ration (a 50:50 mix of average/poor-quality grass silage plus straw) for the period leading up to the transition dry period. Make sure fat mobilisation is not excessive close to calving and keep an eye on the fat cows after calving
- Dry matter intake
  - Maximise in the late dry period to maintain rumen fill
  - Ensure >1 m feed space per cow in the transition period
  - Offset feed rails or use flexible barriers to improve access
  - Use smooth feed surfaces to encourage intake
  - Minimise group changes around the transition period to reduce stress
  - Rationing – an appropriate ration formulated to meet the requirements of your cows should be discussed with your nutritionist
- Targeted use of monensin
  - Available in the UK as a bolus administered 3–4 weeks before calving can help drive glucose production and reduce ketosis risk
  - Cows that benefit from treatment include cows that are very fat (BCS>3.5) or very thin (BCS <2.5) and cows pregnant with twins
- Use of rumen-protected choline and/or methionine to help fat mobilisation out of the liver can be useful
- Always discuss with your vet other possible preventative options

Herd health planning

- Monitoring energy balance
  - Blood samples for NEFA (Non-Esterified Fatty Acids) and BHB can be taken to estimate the rate of disease in your herd. The timing of sampling and number of cows to sample should be discussed with your vet
  - Monitoring milk quality alone can produce misleading results. However, new milk assessment technologies (MIR – Mid-InfraRed) are offering an alternative method to assess energy balance in dairy herds
- Monitoring body condition score
  - Strategic body condition scoring will help you identify key problem areas
  - Are your cows losing condition in the first month post-calving?
  - Are your cows too fat at dry-off?
- Monitor disease incidence
  - Ketosis is a gateway disease so monitoring rates of other diseases in your herd may help you identify whether you have an issue
- Cowside BHB sampling and correct treatment
  - Even the best managed herds will experience some level of subclinical ketosis: identifying cows that are struggling (i.e. BHB >1.2 mmol/l) and treating with propylene glycol can help reduce the knock-on effects
  - Use a handheld BHB meter (relatively cheap and simple to use) to monitor your fresh cows' status
- Teamwork
  - Ensure good communication between your nutrition advisor, vet and whoever feeds your cows

Produced for you by:

AHDB Dairy
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

T 024 7669 2051
E comms@ahdb.org.uk
W ahdb.org.uk
@AHDB_Dairy

If you no longer wish to receive this information, please email us on **comms@ahdb.org.uk**

40010 0722