Ketosis is a metabolic disease that occurs when the cow is in severe negative energy balance and cannot efficiently use mobilised body fat for energy. There are three main types of ketosis:

- **Type 1 ketosis** is a result of a sudden drop in energy intake. This can be due to underfeeding or adverse weather events (e.g. snow storms) that prevent the cows from eating sufficient amounts of dry matter.

- **Type 2 ketosis** generally occurs post-calving, when the cow is mobilising excess body fat to meet the demands of milk production. Cows that are too fat at calving (BCS > 5) or cows that have been overfed pre-calving are particularly at risk.

- **Silage ketosis** is due to cows ingesting poor quality silage. The silage undergoes a secondary fermentation and when ingested will increase the risk of ketosis.

A blood test can be used to diagnose ketosis, but in order to diagnose this condition correctly, measurements should include the ketone body “BOH” along with glucose and non-esterified fatty acids (NEFA).

Ketosis can be prevented by managing feed allocation and BCS (both pre and post-calving) and by paying attention to cow behaviour and adverse weather conditions. **Ensure feed supply meets feed demand.**

**What is ketosis?**

Ketosis is a metabolic disease that occurs when the cow is in a state of severe negative energy balance.

In this state, the cow will mobilise a lot of body fat; however, due to the demands for glucose production, the body fat cannot be converted to energy through the usual pathways. Instead, intermediates in the breakdown of body fat are converted to ketone bodies, such as Beta-hydroxybutyrate (BOH), which, in small amounts, the cow can use as an alternative energy source.

When the level of BOH increases in blood beyond the capacity of tissues to use it, and combined with high levels of fatty acids and low levels of glucose (Table 1), the cow is in a clinical state of ketosis.
Symptoms of ketosis

Ketosis can be displayed in two ways:

1. Wasting form
   • Lethargy (head down, lack of energy)
   • Decreased dry matter intake
   • Decreased milk production
   • Often a sweet smell on the breath (acetone)

2. Nervous form
   • Excitable, uncoordinated and can become aggressive
   • Strange behaviour such as eating soil, licking fence posts and gates, walking in circles, or standing with heads raised up and pushed into a corner etc.

What can the farmer do to avoid ketosis?

Ketosis can be avoided by:

• Ensure cows calve at recommended BCS targets – 5.0 for mixed aged cows, 5.5 for heifers and second calvers
• If at target BCS, feed springers 80-90% of energy requirements during the last one to two weeks pre-calving
• Good feed management in early lactation – target post-grazing residuals of 1500-1600 kg DM/ha and take into account adverse weather conditions
• Avoid feed restrictions if possible (i.e. use supplementary feeds); if restrictions are unavoidable, introduce the feed shortage gradually or milk cows once-a-day
• Ensuring silage is of high quality, and stored correctly.

Treatment of ketosis

If a cow shows clinical signs of ketosis, seek advice from your vet.

Treatments that have been used in severely affected cows include intravenous metabolic solutions (e.g. 4-in-1; Ca, Mg, P, glucose), intravenous dextrose and multivitamin injections.

What you can do:

If the affected animal is still able to stand:
• Increase energy content of the diet.

If the animal is not able to stand:
• Provide it with shelter, soft bedding and continued nursing, including regular rolling from side to side to avoid sores.
• Provide water and high-quality supplements, supported by oral administration (twice daily) of glucose precursors such as propylene glycol.
• Use hip-lifters or similar lifting devices to assist the affected cow to her feet for some time. Hip clamps can only be used to help a cow stand, but not to keep her standing. A sling may be used for up to one hour only if the cow cannot support her own weight.

(cont’d overleaf)
Therefore, in the NZ pasture-based system, ketosis should not be diagnosed based on BOH concentrations alone. Additional indicators of energy balance, in particular NEFA (and glucose if possible; Table 1) should also be measured before ketosis can be properly diagnosed.

For example, in spring on pasture-based systems, if there are high BOH concentrations but NEFA concentrations are within the optimal range, then this is unlikely to represent ketosis. If high BOH concentrations are associated with high NEFAs, then this may reflect an inability of the cow to eat sufficient pasture and is likely to represent ketosis.

Table 1: Three main blood metabolites and optimum concentrations to determine ketosis in pasture-based dairy cows

<table>
<thead>
<tr>
<th>Blood metabolite</th>
<th>Optimum plasma concentration</th>
<th>Extra Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEFA</td>
<td>&lt;0.7 mmol/l (lactating cows)</td>
<td>Free fatty acids are produced by cows when they mobilise body fat and lose body condition, e.g. at the start of lactation.</td>
</tr>
<tr>
<td></td>
<td>&lt;1.4 mmol/l (dry cows towards end of pregnancy)</td>
<td></td>
</tr>
<tr>
<td>Glucose</td>
<td>&gt;3.0 mmol/l (in serum)</td>
<td></td>
</tr>
<tr>
<td>BOH</td>
<td>&lt;1.0 mmol/l (lactating cows)</td>
<td>BOH concentrations increase as the animal is under increased stress.</td>
</tr>
<tr>
<td></td>
<td>&lt;0.6 mmol/l (cows at drying off)</td>
<td>BOH concentrations are also affected by energy status and the diet. Feeding high amounts of pasture increases the blood BOH concentration of cows.</td>
</tr>
</tbody>
</table>

If these blood metabolites fall outside their optimum concentration, the risk of clinical and subclinical ketosis is increased and vet advice should be sought.

References:

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This resource is designed to provide general guidance on particular topics in a timely manner. This DairyNZ information is prepared with due care and based on research to date.