Interreg North-West Europe
HappyMoo
European Regional Development Fund

NEGATIVE ENERGY BALANCE IN DAIRY COWS

Limiting its consequences through vigilance at key periods!

INNOVATION

Negative energy balance: several causes are possible

A dairy cow is in negative energy balance (NEB) when her diet does not cover her energy needs (energy deficit). To meet her needs, the dairy cow mobilises its body reserves, which are used as a new source of energy to ensure vital functions and milk production. This state can be observed:

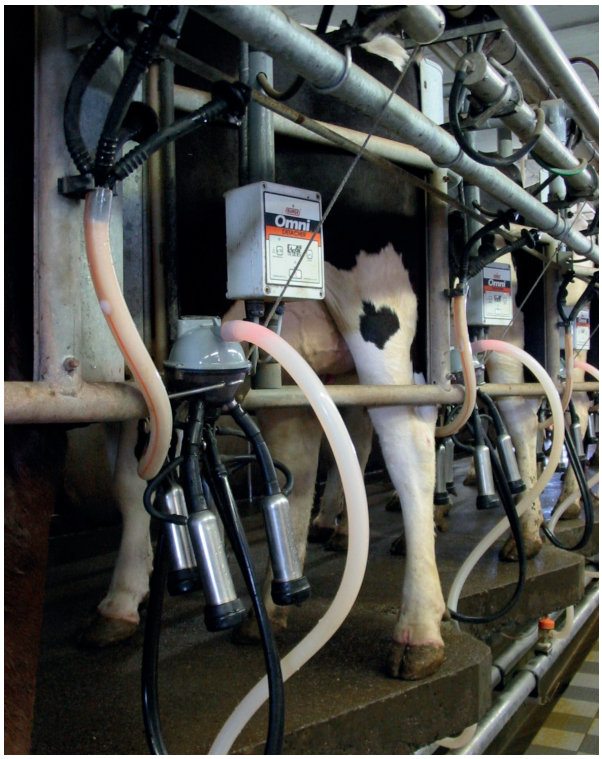
- **During the weeks following calving**. In this case it is related to the onset of lactation which requires a lot of energy at a time when intake is limited. If NEB is physiologically normal in dairy cows at the beginning of lactation, limiting its intensity and duration will avoid reaching a state of ketosis and its deleterious consequences.
- **When dairy cows are undernourished**. This may be due to overly severe rationing, a shortage of feed stock, or poor grass growth.
- **As a result of a health problem** (e.g., lameness, acidosis...) **or stress** causing a drop in feed intake.

The intensity of NEB varies according to the milk potential of the dairy cows, the ration offered (in quantity and quality) and the body condition of the dairy cows. Furthermore, the factors leading to NEB can occur at the same time and aggravate the energy deficit of the dairy cow and its consequences.

Short- and long-term consequences that lead to economic losses

- **On the health of the animals:** more frequent occurrence of diseases (digestive disorders, locomotor problems, uterine diseases, which can also be the cause of NEB), especially ketosis, increase in somatic cell counts, loss of condition or even weight loss.
- **On milk production:** decreases in milk yield that can be very sharp, increase in the fat content (FC) and decrease in the protein content (PC) and lactose concentration.
- **On the reproduction of cows:** reduced fertility, anoestrus, delayed fecundation.

When NEB appears following a drop in intake or a feed restriction, the effects are temporary, the condition of the animals and their production returning to normal when the cows are re-fed ad libitum. In contrast, a high energy deficit in early lactation can lead to long-lasting consequences, from a persistent drop in production throughout the lactation to possible culling.



Ketosis: the main pathology linked to energy deficit

At the start of lactation, the dairy cow's energy requirements are multiplied by 2 or 3 until the lactation peak, which occurs 4 to 6 weeks after calving. At the same time, the cow's intake capacity is limited (-10 to -30% around calving). This will only reach its maximum level 2 to 3 months after calving. Consequently, **all cows are in an NEB at the beginning of their lactation and mobilise their body reserves** to provide the nutrients necessary for milk production.

This mobilisation of reserves leads to the release of non-esterified fatty acids (NEFA) which are taken up by the liver and then oxidised to become energy precursors for the body, or triglycerides. However, this oxidation requires a lot of energy. When the energy deficit is too high, this energy is lacking and the oxidation of NEFAs is incomplete. This leads to the synthesis of ketone bodies (acetone, beta-hydroxybutyrate (BHB) and aceto-acetate) which accumulate in the liver or blood. **This is ketosis**.

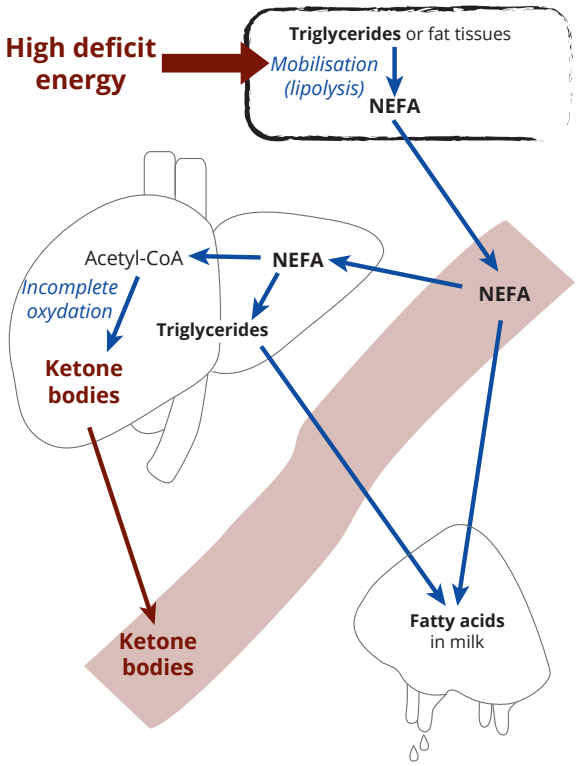
Ketosis is the pathological consequence of an excessive energy deficit in early lactation! This metabolic disease can be:

- **subclinical:** the blood concentration of ketone bodies is high, but no symptoms are visible ;
- **clinical:** in addition to an elevated blood ketone bodies concentration, there may be a significant decrease in milk yield, lethargy, loss of appetite and other visible symptoms.

Ketosis is aggravated by a high body condition score at calving, which leads to an accumulation of triglycerides in the liver called steatosis.

Ketosis is estimated to affect 25% of the dairy cows, especially high producing cows, and has immediate (lower milk production, higher FC, lower PC) and longer term (delayed reproduction, increased risk of other diseases, culling) consequences. Clinical cases represent only 1 to 2% of cows. Economic losses are estimated at €250 per case of ketosis, of which only one third are direct costs (mortality, treatments, labour, diagnosis) (McArt et *al.*, 2015).

Early detection using milk analysis (Fat to Protein Ratio > 1.5, measurement of acetone and BHB concentrations by MIR spectrometry) can limit these consequences.



Preventing energy deficiency through appropriate feeding practices

The beginning of lactation is the period when NEB is most frequent. To limit its intensity and duration, and therefore its consequences, good control of feeding habits around the dry period is necessary. Some recommendations to achieve this:

- offer a palatable ration adapted to the low energy needs of cows during the dry period to **maintain a good level of intake while avoiding fattening of cows before calving;**
- gradually increase the amount of concentrates in the days before calving to **prepare the rumen to ingest a high energy density ration** necessary for a good start to lactation;
- Pay particular attention to **high producing dairy cows and cows that have suffered from ketosis in a previous lactation**;
- **Minimise the incidence of diseases that can reduce intake** such as lameness, mastitis and peripartum disorders.

But early lactation is not the only period of risk. In general, constant attention should be paid to the ration offered by providing quality forage and using quality concentrates if necessary to balance the ration, making 2–3-week transitions between diets, and avoiding any form of stress (including disease) that may reduce intake. Finally, avoiding large variations in body condition score is recommended.

Early detection for early reaction!

Regular monitoring of the status of animals is the best way to react in time! For this, it is necessary to have indicators that are easy to use on a routine basis.

The body condition score (BCS) is the reference indicator for characterising the energy balance. But this indicator is subjective and too late. In other words, when a cow with a low BSC is found, it is often too late!

Blood tests for NEFA and ketone bodies (especially BHB) exist but are invasive and expensive.

Analyses performed in milk are the most suitable for regular and individual monitoring of herds.

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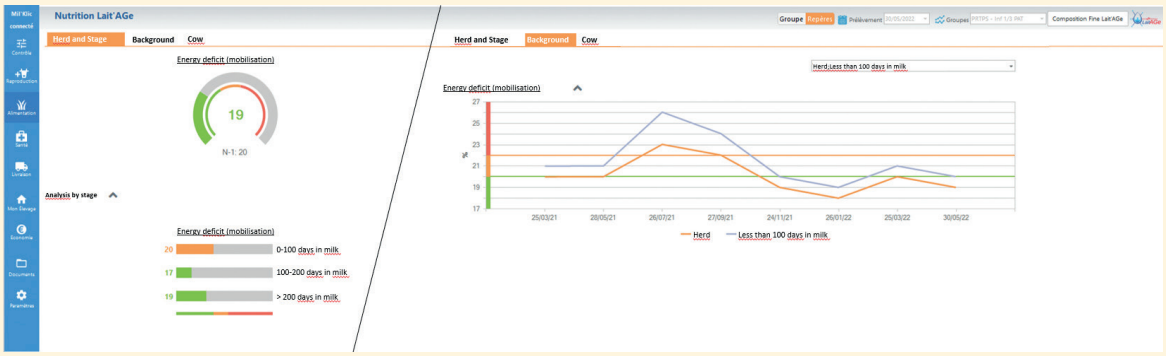
In France, for example, a service called CetoDetect® allows the detection of cows in subclinical or clinical ketosis via a milk analysis without the need for a BHB blood test. Another service, called «LaitAGe», allows to evaluate globally and over time the level of energy deficit of dairy cows (whole herd, or by stage of lactation) from the profile of fatty acids in milk. For the farm presented below, we observe an energy status within the norm for the herd, with a greater deficit for cows at early lactation and during summer.



The HappyMoo project: monitoring tools for happy cows

This document was produced in the framework of the Interreg NWE HappyMoo project, financed by the European Union and co-funded by the Walloon Region in Belgium.

The HappyMoo project aims to provide dairy farmers, veterinarians and advisors with a tool to assess the well-being of dairy cows and in particular the absence of disease, hunger and stress. Monitoring energy deficit is a key element to ensure that cows are not hungry. The HappyMoo project teams have been able to identify several traits in milk which can be used to routinely, rapidly and at low cost identify cows at risk or with problems. Thus, equations have been developed from the mid-infrared spectra of milk to predict the concentrations of some metabolites of interest, including ketones, but also the weight and body condition score of cows, their feed intake, their feed efficiency, and their energy balance.

Find all the results of the HappyMoo program on the website

https://www.nweurope.eu/projects/project-search/happymoo/

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