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SRUC

Metabolic Profiling in the Suckler Herd

Summary

- **Metabolic profiling is a useful management tool to "ask the cows" what they think of their diet, to assess nutritional and health status of the herd.**
- **Metabolic profiling involves analysing blood samples to investigate various parameters to provide information on protein, energy and mineral status of the cows. This can give an indication of both the short-term and longer-term nutritional status of the herd.**
- **The key time to blood test is in the pre-calving period to help optimise nutrition and health of both the cow and calf at calving, as well as subsequent cow fertility.**
- **The key recommended time to blood sample is within one month prior to the start of calving.**
- **Sampling again two to three weeks after calving can also be useful to check on post-calving nutritional status.**

Introduction to Metabolic Profiling

Metabolic profiling involves blood testing cows at key times of the production cycle to assess nutritional status.

It is often used as a management tool in the dairy herd to help fine tune nutrition over the transition period to help reduce the risk of metabolic diseases and suboptimal fertility, and has been used for many years in pregnant sheep prior to the start of lambing.

However, it is less commonly used in beef herds and is useful to assess energy status and protein nutrition, as well as testing for key mineral elements.

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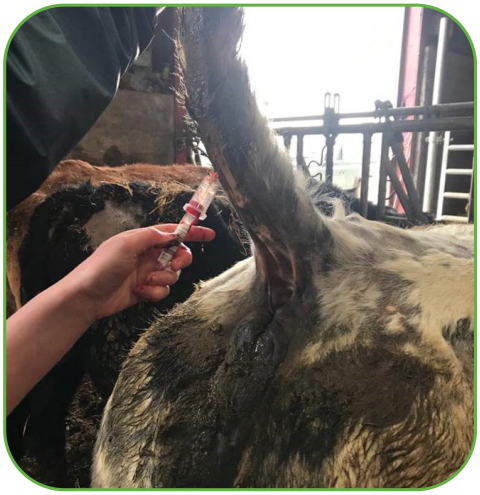
Reasons to Test

Profitability in the suckler herd relies on getting cows in calf and maximising calf output in terms of numbers weaned per 100 cows put to the bull. Nutrition in the pre- and post-calving period can have a huge influence on this. Nutritional limitations are a common cause of cows failing to get back in calf, resulting in substantial economic loss. Blood testing is a quick and cost-effective way to assess nutritional status, and allow corrective action to be taken to help protect calf health and herd fertility. Suckler cows are often fed on poor quality silage or straw and these can be lacking in protein, leading to poor rumen function and reduced colostrum and milk yield post-calving. Low magnesium is commonly diagnosed in suckler cows over the calving period, increasing the risk of slow calvings and hypomagnesaemia (staggers) during lactation. Many of these problems can be identified through metabolic profiling and corrected, helping preserve health and fertility in the herd.

When to Sample



A minimum of six cows per group should be blood sampled, and these animals should be representative of the herd. The best time to blood sample is in late pregnancy (ideally within one month prior to the start of calving), and then potentially two to three weeks post-calving. It is important that cows have had at least two weeks to adapt to any ration changes before blood sampling in order for the results to reflect the new ration. Ration details and forage analysis, along with calving date, body weight and condition score for each cow sampled must be submitted for accurate interpretation of results.

Care must be taken that cows have sufficient access to feed in the period before blood sampling. Any restricted access to feed in the previous 24 to 48 hours will affect results, with many blood parameters sensitive to changes in short-term feed intake.

What is Tested for?

A range of parameters can be measured to assess energy, protein and mineral status, as well as picking up indications of disease. The following are most commonly tested for, but other tests are also available upon request, such as plasma inorganic iodine (PII) or thyroxine to assess iodine status, and calcium:

- **Energy status: beta-hydroxybutyrate (BHOB), non-esterified fatty acids (NEFAs) and glucose.**
- **Protein: urea, albumin and globulin.**
- **Major minerals: phosphorus and magnesium.**
- **Trace elements: copper and GSHPx (a selenium dependent enzyme which serves as an indicator of selenium status).**

Interpreting Results

The following table details the parameters measured in blood, target levels and what they indicate:

Blood parameter	Optimum levels		What it means?
	Pre-calving	Post-calving	
Beta-hydroxybutyrate (BHOB) (mmol/litre)	<0.6	<1.0	One of the ketone bodies produced when cows oxidise fats or acetate/butyrate produced from mobilisation of body fat. This occurs at a slightly later stage in the fat mobilisation pathway compared to NEFA production.
Glucose (mmol/litre)	>3.0	>3.0	A short-term measure of energy supplied from the rumen. It is kept under tight hormonal homeostatic control (via insulin and glucagon), and so levels tend to be fairly stable, unless cows enter severe negative energy balance.
Non-Esterified Fatty Acids (NEFAs) (mmol/litre) Urea-N (mmol/litre)	<0.4	<0.7	A short-term (over the previous two weeks) indicator of energy supplied from body fat mobilisation, which occurs when cows are in negative energy balance. This can occur when energy intakes are insufficient to meet requirements for maintenance, growth, pregnancy and lactation.
Urea (mmol/l) (Urea-N x 2.14)	1.7 - 3.5 3.6 - 7.5	1.7 - 3.5 3.6 - 7.5	Assesses protein intake and utilisation in the rumen, and whether there is sufficient Effective Rumen Degradable Protein in the ration for adequate rumen function.
Albumin (g/litre)	>30	>30	Low levels suggest poor liver function, poor long-term protein status or a disease issue such as liver fluke or Johne's Disease.
Globulin (g/litre)	<50	<50	High levels indicate a chronic inflammatory condition such as mastitis or lameness.
Magnesium (mmol/litre)	0.8 - 1.3	0.8 - 1.3	The mineral element most often deficient in suckler cows over the calving period. Important for calcium mobilisation at calving to help maintain muscle function, reducing the risk of slow calvings, retained foetal membranes and milk fever, as well as hypomagnesaemia (staggers) during lactation.
Phosphorus (mmol/litre)	1.4 - 2.5	1.4 - 2.5	An important major mineral for bodily functions and energy metabolism.
Copper (µmol/litre)	9.4 - 19.0	9.4 - 19.0	Important role in health, fertility and immunity. Blood levels tend to be relatively constant unless excessive overfeeding or underfeeding. Liver copper analysis will give a more accurate indicator of copper status.
GSHPx (Selenium) (units/gm Hb)	>50	>50	Indicates the selenium status of the animals over the past few months. Optimum value varies between laboratories due to different methods used.
Thyroxine T4 (nmol/litre)	>20	>20	Reflects iodine status in late pregnancy. Can be useful in stillbirth investigation. Affected by metabolic rate and time after calving.
Plasma Inorganic Iodine (PII) (µg/l)	50 - 105	50 - 105	Reflects short-term iodine intakes in the previous 24 hours. Expensive test, and so pooled samples often used for group status.

These values are only a guide and should be interpreted in conjunction with individual cow information based on health status, body condition, stage of pregnancy/lactation etc. Consider the group mean results as well as variation within the group, how many abnormal values there are and their magnitude. Some of the most common findings in suckler cow metabolic profile tests are discussed in the following sections.

Low Magnesium and Feeding Recommendations

A Scottish Government funded project in 2020 involving 12 spring calving herds showed that over one third of cows blood sampled in the month before calving had low magnesium levels. A larger scale study by the University of Edinburgh blood tested 988 spring calving suckler cows across 80 farms, and showed that 29% of cows had low blood magnesium levels in the last month of pregnancy.

Magnesium has an important role in supporting the hormones involved in mobilising calcium from bones and increasing calcium absorption from the gut. Calcium is important for smooth muscle function and muscle contractions during the birthing process and for this reason, low magnesium intakes can result in poor muscle tone, slow calvings and more retained cleansings. Low magnesium status will also increase the risk of milk fever. If blood calcium levels are low (secondary to a lack of magnesium supplementation), uterine contractions are less pronounced, which can prolong the first stage of labour. A calf born from a slow calving may be weak, with poor vigour, meaning that it may take longer to stand and get sufficient colostrum in a timely manner to maximise immunity. Poor muscle tone in the dam can also affect gut motility, reducing dry matter intake with knock-on effects on energy status, milk yield and subsequent fertility.

Recommended intakes of magnesium are 20-30g/cow/day from the overall ration (with the upper level being the target for lactating cows). However, if potassium levels in grass/forage are high (2-3%), then 30-40g of magnesium intake should be the target from the total diet as potassium can reduce magnesium absorption in the gut. A forage mineral analysis is useful to assess the potassium level and whether current mineral supplementation is sufficient, not just for magnesium but for other minerals and trace elements.

As a guide, a cow eating 10kg dry matter of grass or grass silage would get around 16g of magnesium. If straw made up half the ration, then only 11g of magnesium would be supplied from the ration. Introducing a high magnesium mineral supplement three weeks prior to calving will help meet requirements.

- **100g of a 10% magnesium mineral supplies 10g of magnesium**
- **150g of a 10% magnesium mineral supplies 15g of magnesium**
- **100g of a 15% magnesium mineral supplies 15g of magnesium**
- **100g of a 25% magnesium mineral supplies 25g of magnesium**

High NEFAs and Impact on Subsequent Fertility

High NEFAs are associated with excessive mobilisation of body fat reserves and therefore body condition score loss. It is recommended that spring calving suckler cows maintain their condition after calving (at the target body condition score of 2.5 to 3) and that autumn calving cows (and heifers in both block calving groups) lose no more than half a body condition score unit between pre-calving to breeding. Any condition score loss greater than 0.5 a unit will greatly impact on how quickly the cow resumes oestrus cycles post-calving and negatively affect conception rate.

Body condition score at calving is one of the main factors that influences the length of the anoestrus period after calving, and it is widely recognised that high NEFAs in dairy cattle have been shown to impair subsequent fertility. Dairy cows with high NEFAs before calving have been associated with a 19% reduction in the likelihood of becoming pregnant in the subsequent lactation, and those with high NEFAs after calving being 16% less likely to become pregnant (Ospina et al, 2010). Although similar work has not been undertaken in beef cows, it is highly likely that excessive body condition score loss in suckler herds will also prolong the anoestrus period and affect the ability of the cow to get back in calf within the desired period.

For cows that calved in poor body condition (below BCS 2.5 out of 5), it is likely that providing supplementary feed to cows immediately after calving will have little effect on improving subsequent fertility but will help prevent further condition loss. Therefore, nutrition should focus on achieving the target condition score at calving.

Low Blood Urea

Low blood urea levels have been commonly diagnosed in beef cows, especially those which are fed on low quality forages and straw pre-calving, leading to a deficiency of rumen degradable protein. An adequate supply of rumen degradable protein is important for the rumen microbes to synthesise microbial protein, which is high quality protein that is delivered to the small intestine for digestion. This process of microbial protein production also requires sufficient fermentable energy which comes from starch, sugar and soluble fibre sources. Protein is important for many functions including growth, maintenance of body protein reserves, maintenance of pregnancy, calf growth, milk production and fertility.

In extreme cases where insufficient rumen degradable protein is available (usually when the crude protein level in the diet drops below 9% on a dry matter basis), rumen impaction may occur. This is where normal flow of digesta through the rumen is impeded due to accumulation of indigestible feeds, resulting in over-filling of the rumen. Symptoms include discomfort and distension of the abdomen, markedly reduced feed intake, poor rumen motility, production of very little and hard, dry faeces and even death. Low blood urea can be corrected by feeding forages with a higher protein content or supplementing with high protein feeds such as rapeseed meal, soybean meal, distillers' dark grains, distillery by-products (draff) and liquid feeds.

Conclusions

Metabolic profiling in suckler cows pre- and post-calving is a useful exercise to objectively assess nutritional status, and allow fine-tuning of rations to optimise health and subsequent fertility. It provides an indication of whether the ration is sufficient to meet the protein and energy requirements for the stage of production the herd is at, and can also be used to diagnose some mineral deficiencies. Sampling procedures and additional information on body condition, forage quality and rations are important for interpretation of the results on which to base nutritional management changes on. From previous research, the parameters most likely to fall outwith the normal range are NEFAs, urea and magnesium, and care should be taken to meet nutritional requirements both pre- and post-calving in the suckler cow. In addition, achieving the target body condition score at calving will go a long way to help optimise calving performance and subsequent fertility in the beef herd.

Reference

Ospina, P.A., Nydam, D.V., Stokol, T and Overton, T.R. 2010. Associations of elevated nonesterified fatty acids and β-hydroxybutyrate concentrations with early lactation reproductive performance and milk production in transition dairy cattle in the northeastern United States. Journal of Dairy Science 93 (4): 1596-1603.

Authors

Lorna MacPherson
SAC Consulting, Thainstone Agricultural Centre, Inverurie, Aberdeenshire, AB51 5WU / Tel: 01467 625385

Karen Stewart
SAC Consulting, 77 North Street, Forfar, Angus, DD8 3BL / Tel: 01307 464033

Alastair Macrae FRCVS
Dairy Herd Health and Productivity Service (DHHPS),
The Royal (Dick) School of Veterinary Studies and The Roslin Institute,
Easter Bush Veterinary Centre, Midlothian, EH25 9RG / Tel: 0131 651 7474

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