Metabolic profiling of ewes to improve efficiency and production

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Published in:
Farming Connect

Publication date:
2019

Citation for published version (APA):
Williams, C. (2019). Metabolic profiling of ewes to improve efficiency and production. *Farming Connect*.

Metabolic profiling of ewes to improve efficiency and production

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Take home messages:

- The time just before and just after birth is extremely demanding for ewes in terms of energy.
- Inadequate management during this period can often cause serious and costly disorders.
- Metabolic profiling is becoming more cost-effective as technology develops, and pooled sampling can be used to reduce test costs while obtaining in-depth data.

The metabolic profiling of an animal involves analysis of a blood sample to evaluate its internal functions; the results can then be interpreted to assess health and nutritional status. Of particular interest, are ewes in the "transition period" – the time 3 weeks before and 3 weeks after birth. This information can be used in the diagnosis and prediction of diseases in both the flock and individual.

Metabolic profiling requires a simple blood draw from animals. The time of sampling relative to feeding is important, as feeding management should be consistent across animals to ensure accurate and representative results. The blood is then analysed to assess levels of substances linked to significant diseases and health problems. The modern metabolic profiling process is able to cope with large flock sizes and provide accurate, in-depth and cost-effective analysis. It is also essential that a metabolic profile be combined with other information including flock and animal records, facilities and rations to ensure its effectiveness as a diagnostic tool.

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Biological Principles

The transition period is an exceptionally important stage in which the ewe's metabolism is key, as disruptions and imbalances can lead to metabolic disorders (*e.g.* pregnancy toxaemia) and increased susceptibility to infectious diseases (*e.g.* mastitis).

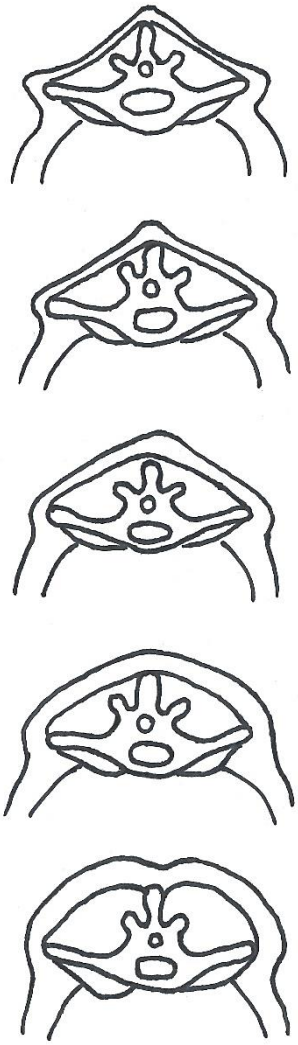
There is a great energy demand during the transition period, from the growing foetuses (ranging from one to five offspring), the labour and birthing process and for production of colostrum and milk. Such demands often cause animals to go into a Negative Energy Balance (NEB) where the animal uses more energy than it is taking in. Whilst this is a normal temporary response, severe cases can cause problems. This lack of energy tends to occur in late pregnancy when feed intake is low (due to the volume of the uterus, which occupies an increasing volume in the abdomen) but energy demand is high. Low blood sugar causes reserves of body fat to be broken down and converted into energy by the liver. A by-product of this process is ketones; these occur naturally in the body but high levels can cause serious health problems (*i.e.* pregnancy toxaemia and acidosis). Some fats that are liberated escape the breakdown process and are instead deposited in the liver leading to fatty infiltration in the liver and kidneys, which greatly impairs function.

β - hydroxybutyrate (BHB) is one such ketone, which is widely used in diagnostic tests and metabolic profiles. Heightened levels of BHB are an accurate predictor of energy status and as a diagnostic tool for pregnancy toxaemia. Ewes carrying multiple foetuses are most at risk of toxaemia, although age and breed does not have a significant effect. Ewes with toxaemia have far higher odds of foetal death when compared to normal ewes and show clinical symptoms such as anorexia, weakness, depression and if left untreated may lead to death.

Body condition scoring (BCS) is also strongly linked to metabolic status and hormone levels (Figure 1). At a low, underweight BCS (1.25 and 2) ewes recorded had lower glucose levels and higher ketone levels. At a high, overweight BCS (4+), high insulin and urea levels have been recorded. It is recommended to aim for a BCS of 2.5 to 3 to assure nutritional and metabolic welfare, which can be achieved through frequent and accurate scoring. This varies according to the breed and at where in the reproductive cycle the ewe may be (Table 1). In order to confirm and refine the first

BCS measurements, a metabolic profile may be used. When choosing which individuals to select for metabolic profiling, BCS may be used to assign individuals to the appropriate group.

Body Condition Scoring



Score 1
Vertical and horizontal processes are prominent and sharp. Fingers can be easily pushed beneath the transverse.
Loin is thin with no fat cover.

Score 2
Vertical processes are prominent and smooth. Horizontal processes are smooth and rounded but it is still possible to press fingers under.

Score 3
Vertical and horizontal processes are smooth rounded, the bone is only felt with pressure.

Score 4
Vertical processes are only detectable as a line. Horizontal processes cannot be felt.
Loin muscle is full and rounded with a thick covering of fat.

Score 5
Vertical and horizontal processes cannot be detected and there is a dimple in the fat layers where the processes should be.
Loin muscle is very full with very thick fat cover.

Figure 1: Body condition scoring chart for sheep (adapted from https://beefandlamb.ahdb.org.uk/wp-content/uploads/2013/06/brp_l_Sheep_BCS_190713.pdf).

Stage	Hill ewes	Upland ewes	Lowland ewes
Weaning	2	2	2.5
Tupping	2.5	3	3
Mid-pregnancy	2	2.5	3
Late pregnancy	2	2.5	3

Table 1: Optimum body scores for hill, lowland and upland ewes at various stages in the reproductive cycle.

Mineral levels play a key role in the production of sheep, in particular calcium (which relates to milk fever/hypocalcaemia) and magnesium (which relates to grass staggers/hypomagnesaemia). Normally, these minerals are carefully balanced by the internal functions of the animal; however, in negative energy balance this is often disrupted. Additionally, in sheep, no magnesium stores are contained within the body and calcium is rapidly utilised in the production of milk as well as in bone generation in the foetus leading to deficiencies. A metabolic profile may be able to predict mineral deficiencies before symptoms begin to show, allowing prompt treatment and reducing the risk of complications. The addition of limestone, a magnesium containing supplement or a loose lick containing calcium can help to prevent grass staggers and milk fever. Ewes should be grouped according to the number of lambs they are carrying in addition to their BCS to provide targeted feeding.

Value and Implementation

Unresolved or severe negative energy balance in the ewe can lead to increased risk of metabolic diseases as well as losses in productivity and therefore in profit. In the worst-case scenario, this could include the death of the ewe and her offspring and in the best case, additional labour will be required and medical treatment sought (IV calcium, oral dosing with glycerol or sodium bicarbonate *etc*.). The cost of treating toxaemia is certainly more expensive than preventative measures such as body condition scoring ewes regularly, providing the correct nutrition and treating any health problems promptly.

There are two main reasons for metabolic profiling in livestock: as a diagnostic tool for a specific disease or as a predictor for disorders. Essentially, this is the difference between sampling a small population of affected animals to diagnose a disease versus the collection of samples from “normal” individuals to identify disease risk and nutrient status.

Using “pooled” samples can also help make the process more cost effective and is useful in screening for disease risk in the flock. The optimum number of individual samples ranges between 8 and 12 depending on flock size.

A qualified vet will take the blood sample, as well as perform any processing required then send for profiling. It is essential that the farmer work closely with their vet to get the most out of metabolic profiles, the vet will enable accurate interpretation of the results and can help establish a herd health plan to ensure optimum nutrition and health of ewes and lambs.

Summary

In the past, cost and interpretation of metabolic profiles have been a limiting factor, but as technologies have developed, it has become more economically viable to profile the flock. Metabolic profiling coupled with regular body scoring can provide precise and accurate information with regards to disease risk in the flock. When a metabolic profile is well-timed it can provide essential information to help the farmer optimise nutrition thereby decreasing waste, optimising productivity and avoiding costly vet bills or loss of stock. In turn, this can increase profitability as well as the health and welfare of the flock.

February 2019

Note to editors:

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Background information:
This project has received funding through the Welsh Government Rural Communities - Rural Development Programme 2014-2020, which is funded by the European Agricultural Fund for Rural Development and the Welsh Government.
The Farming Connect Knowledge Transfer Programme and Advisory Service is delivered by Menter a Busnes on behalf of Welsh Government. Lantra Wales leads on the delivery of the Farming Connect Lifelong Learning and Development Programme.

Keywords: *Metabolic profiling, ewes, sheep, transition period, lambing, livestock, metabolic disease, disease, toxaemia, diagnosis.*

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