

Importance of Metabolic Profiling in Dairy Cows

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Introduction

Study of metabolic profiling in dairy cows especially at peripartum period or transition period, 21 days prior calving and 21 days after calving which mainly helps to identify the sub-clinical form of metabolic changes or disorders; it is most stressful period during early lactation. Especially in dairy cows at periparturient period it is the most dangerous period for cow as well as for the farmers, approximately 75% of dairy cows are prone to metabolic disorder which occurs especially at first month of calving.

Vulnerable disease in peripartum period that includes milk fever, ketosis, mastitis & fatty liver syndrome are encountered at this phase which can cause severe financial problems. These increased incidences of diseases observed at peripartum period can cause disturbances in health status and productivity of dairy cows in future, and this activity can alter the immune response of dairy cows.

Disease outbreaks in dairy cows can cause financial burden and the value of the euthanasia protocols are increasing simultaneously day by day globally. This period majorly involves drop in feed intake and hormonal changes during non-lactating to lactating stage in dairy cows which makes them more prone to metabolic disorders. For this reason serum level of major macro-minerals levels like glucose, calcium, magnesium and potassium are altered due to high requirement of these minerals during this stage.

2. Why metabolic profile is required in dairy cows?

Metabolic profiling is most likely a blood test that helps to detect the early or subclinical stage for, metabolic disorders, and helps to detect the early warning signs. This profiling covers all important minerals like calcium, glucose, magnesium, and potassium which help the farmers to detect and take preventive measures which can, reduce treatment cost and improve milk production.

Metabolic profiling is important because a healthy cow might not show early symptoms related to metabolic disease but inside her body could be struggling especially around the time of parturition or calving. At this stage body need more energy, minerals, and nutrient to support both calving and milk production. This simple blood test includes study of details of mineral fluctuation during the stage of calving. Farmers can find out if something is wrong before the cow get visibly sick. If glucose level is low, there may be ketosis, if calcium level is low then there maybe problems like milk fever which can lead to severe metabolic problems like downer cow syndrome, if liver function markers are off, it might mean cow is not breaking nutrient properly. Early detection through metabolic profiling helps farmers: to reduce number of sick animals, avoid treatment cost; improve milk quality and quantity, and keeps cows healthier for longer period.

Transition period (from three weeks before to three weeks after calving) is most stressful time in dairy cows and generation of oxidative stress is major concern during this transition period when reactive oxygen species (ROS) exceeds the cow anti-oxidative defence capacity, leading to cellular damage and weakened immunity. This condition increases the chance for mastitis and metritis.

Nutrition requirement and energy deficit occurs when cows during early lactation stage goes into negative energy balance (NEB). Immobilization of fat, increasing level of non-esterified fatty acid (NEFA) and β -hydroxybutyrate (BHB), may develop and conditions like ketosis and fatty liver occur.

3. When are metabolic profiling needs to be done?

Metabolic profiling is usually done around the transition period, which is most sensitive time period for the dairy cows. This period includes the three weeks before calving and three weeks after calving. During this period body undergoes various changes which include calving to preparing for next milk production. In dairy cows' energy needs increases, feed intake drops massively and the risk of health issues increases and may leads to the problems like ketosis, fatty liver and milk fever.

By testing blood sample during this period can give an overview for farmer and veterinarians

can detect problems early even before cow show symptoms. This helps to take action such as adjusting the diet or providing right nutrition by checking the parity, body condition score (BCS) and body mass index (BMI), or providing treatment to avoid great loss. Metabolic profiling can be repeated before calving (around 21 days prepartum), right after calving (within the first 7-10 days postpartum) or during early lactation especially in high yielding animals.

4. What are the key insights from a cow's blood in metabolic profiling?

Metabolic profiling gives us more than just mineral level; it also helps in understanding how well the dairy cow's organs are functioning and how cow is responding to the stress during calving. Liver enzyme like AST and GGT level can reveal if the liver is under pressure due to fat build-up, total protein and albumin level can indicate cow is getting adequate nutrition or not or suffering from any inflammation, urea and creatinine level gives an insight into kidney function and protein metabolism and antioxidant markers like glutathione peroxidase or malondialdehyde (MDA) values gives an idea about immunity and recovery. By analysing the blood value, we can understand the hidden issues early which can not only prevent major health problems, but also to help improve fertility, milk yield and overall recovery after calving.

5. Factors affecting metabolic profile results in cows

Metabolic profiling results can vary depending on several cow-related and management causes. Understanding this will provide one to interpret the following:

1. Parity (number of calving): Usually first lactation cows often have different metabolic demands compared to older one. even second calving or more are more prone to negative energy balance, which may affect blood glucose and NEFA levels.
2. Body condition score (BCS): Cows that are either too thin or over conditioned before calving face a higher risk of metabolic imbalance. Over conditioned cows may accumulate excessive fat postpartum, leading to elevated NEFA and

BHB; increasing the risk of ketosis and fatty liver.

3. Stage of Lactation: early lactation is most critical phase for metabolic stress. Blood profile during this stage often show drop in glucose, calcium and magnesium while markers like NEFA and BHB may rise sharply.
4. Feeding and nutritional management: What the cow eats before and after calving plays a major role in health. If the diet doesn't have enough energy or the right balance of mineral like calcium and phosphorus it can affect the level of urea, glucose and other minerals.
5. Environmental stress: Heat stress, poor housing system and lack of clean water can worsen metabolic issue, elevate cortisol level can suppress the immune response and affect the liver enzyme.
6. Breed and genetic factors: Highyielding exotic breeds (e.g., Holstein Friesians) have greater metabolic demands and more vulnerable to disorders as compared to native or cross breeds.
7. Disease or subclinical Infections: Even before clinical signs appear, underlying conditions like mastitis or uterine infections may alter protein and inflammatory markers like albumin or globulin affecting the metabolic profiling.

Proper evaluation of these factors is crucial when interpreting profiling reports. A single abnormal value doesn't always mean disease; it must be interpreted with all factors.

6. What are the common metabolic disorders in dairy cows?

Metabolic disorders are common in dairy cows, especially around the time of calving, when the energy demands increase drastically. The major disorders include:

1. Ketosis: This occurs when cows are in negative energy balance and start breaking down fat reserves excessively, leading to increased ketone bodies like β -hydroxybutyrate (BHB) in the blood. It can cause reduced milk yield and appetite.
2. Milk Fever (Hypocalcaemia): A sudden drop in blood calcium after calving causes

muscle weakness, poor coordination, and it may lead to collapse.

1. 3.Fatty Liver: Excess fat mobilization results in fat accumulation in the liver, impairing liver function and energy metabolism.
2. 4.Subclinical Hypomagnesaemia: Low magnesium levels without obvious clinical signs can affect muscle and nerve function, impacting production.

Blood Parameter Changes Associated

1. Ketosis : \uparrow BHB, \uparrow NEFA, \downarrow glucose
2. Milk Fever : \downarrow serum calcium
3. Fatty Liver : \uparrow NEFA, \uparrow liver enzymes
4. Hypomagnesaemia : \downarrow serum magnesium

7. What happens if Metabolic Profiling is ignored?

Neglecting metabolic profiling during the transition period (three weeks before to three weeks after calving) can lead to undetected subclinical metabolic disorders such as hypocalcaemia, hypomagnesaemia, hypophosphatemia, and hypoglycaemia. These conditions may progress to clinical diseases, resulting in decreased milk production, impaired fertility, and increased veterinary costs. Early detection through metabolic profiling allows for timely interventions, preventing these adverse outcomes.

8. How Metabolic Profiling Helps in Decision-Making on the Farm

Metabolic profiling provides farmers with valuable insights into the nutritional and metabolic status of their cows. By analyzing blood parameters, farmers can make decisions regarding dietary adjustments, identify cows at risk of metabolic disorders, and implement preventive measures. This proactive approach enhances herd health, optimizes milk production, and improves overall farm efficiency.

9. Role of Nutrition in Supporting a Healthy Metabolic Profile

Proper nutrition is fundamental to maintaining a healthy metabolic profile in dairy cows. During the transition period, it's crucial to provide balanced diets that meet energy, protein, and mineral requirements. Inadequate nutrition

can lead to negative energy balance, increasing the risk of metabolic disorders. Tailoring feeding strategies based on metabolic profiling results ensures cows receive the necessary nutrients to support health and productivity.

10. Future of Metabolic Profiling: New Technologies and Smart Farming

Advancements in technology are revolutionizing metabolic profiling in dairy farming. Innovations such as wearable sensors, automated blood analysers, and artificial intelligence enable real-time monitoring of cows' metabolic status. These tools facilitate early detection of health issues, allowing for prompt interventions and improved herd management.

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