VETERINARY TODAY INTERNATIONAL
ISSN 2583-8288

Ketosis And Its Importance In The Postpartum Period In Cattle

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doi.org/10.5281/VeterinaryToday.21809308

1. Introduction

Ketosis, metabolic disorder of dairy cows characterised by elevated level of ketone bodies [Beta-hydroxy butyrate (βOHB), acetoacetate (AcAc), and acetone (Ac)] in the blood, urine, and milk. Generally, it occurs during early lactation period. Dairy cows generally experience a state of Negative energy balance (NEB) in transitional period characterized by excessive mobilization of free fatty acids from adipose tissue due to low dry matter intake (DMI). The production of ketone bodies (such as Ac, AcAc, and βOHB) reflects the liver's ability to convert circulating non-esterified fatty acids (NEFA) into glucose through gluconeogenesis (Saradhi *et al*., 2024).

The incidence is notably higher during the winter - spring months, and in areas with poor-pasture supplementation. Additionally, intensive rearing systems contribute to increased susceptibility owing to confinement and sub-optimal forage intake (McArt *et al*., 2012).

Ketosis can be diagnosed with help of clinical signs, dividing it into two forms Sub-clinical ketosis and Clinical ketosis. Sub clinical ketosis is characterized by elevated level of ketone bodies in blood without any overt clinical signs whereas clinical ketosis presents visible symptoms such as Inappetence, licking, blindness, hard dry faeces, rapid weight loss, and decreased milk production (Satoła and Bauer, 2021).

2. Etiology and Pathogenesis of Clinical ketosis in Cattle

In the dairy cows, Ketosis is complex metabolic disorder that arises from negative energy balance. Normally, as parturition approaches, dairy cattle experience a change in their energy metabolism and its regulation, shifting from nutrient accumulation to rapid mobilization of lipid and protein in the preparation for high milk production (Wang *et al*., 2012).

This adipose mobilization is accompanied by high serum concentrations of non-esterified fatty acids (NEFAs). During periods of intense gluconeogenesis, a large portion of serum NEFAs is directed to ketone body synthesis in the liver. Thus, Clinical ketosis is clinico-pathologically characterized by severe hyperketonaemia, manifested by increased serum levels of non-esterified fatty acids (NEFAs) and ketone bodies, (Ac, AcAc and BHBA), accompanied by decreased blood glucose concentrations (Mooli and Ramakrishnan, 2022).

A secondary, causes of ketosis arises from ingestion of silage that has undergone clostridial fermentation to produce high concentrations of butyric acid. Poorly fermented silage containing high concentrations of butyrate is a less common cause of ketosis in dairy cows. Elevated dietary butyrate cannot be metabolized efficiently by the animal, leading to its accumulation in the rumen. The excess butyrate is absorbed through the ruminal epithelium into the bloodstream and subsequently converted into β-hydroxybutyrate (BHBA) in the liver. This increased production of BHBA contributes to the development of ketosis in dairy cattle (Zhang *et al*., 2025).

In the immediate postpartum period, especially during the first week after calving Hyperketonaemia cases are usually associated with fatty liver. Both fatty liver and hyperketonaemia are part of a spectrum of conditions associated with intense fat mobilization in cattle.

At time of peak milk production (usually around 4–6 weeks after parturition but sometimes as early as 2 weeks after parturition) are associated with underfed cattle experiencing a metabolic shortage of gluconeogenic precursors rather than with excessive fat mobilization. This occurs due to high-producing dairy cows experiencing imbalance in the nutritional energy metabolism or in need of immense energy in the production of milk (Sammad *et al*., 2022).

The exact pathogenesis of ketosis in dairy cows remains unclear, as the severity of clinical signs is not directly related to blood glucose or ketone body concentrations. Although cows with clinical ketosis consistently exhibit severe hyperketonemia, not all cows with elevated ketone body levels develop clinical disease (Ha *et al*., 2022).

3. Epidemiology of ketosis in Cattle

Dairy cows in early lactation (the first two months after parturition) are at risk of ketosis, with most cases occurring in the first 15 days of lactation. Ketosis occurs in dairy cows of all parities but the risk increases with increasing parity. Cows with excessive adipose stores (body condition score ≥ 3.75 on a 5-point scale) at calving are at greater risk of ketosis than those with lower body condition scores (Tufarelli *et al*., 2024).

Lactating cows with ketosis are also at a greater risk of developing displaced abomasum than cows with lower blood BHBA concentrations. Ketosis also affects the reproductive health of cows. Ketosis delays the recovery of the uterus and normal reproductive process, leading to prolonged time to service and increased calving intervals and animals are at increased risk of being culled in early lactation (Brunner *et al*., 2019).

4. Clinical Findings of ketosis in Cattle

Clinical ketosis presents obvious signs such as marked loss of appetite, a significant decline in milk production, progressive weight loss, and a characteristic acetone odour on the breath. In contrast SCK is a milder form in which cows show elevated blood ketone levels without obvious clinical signs. Affected animals may exhibit only a slight reduction in feed intake and milk yield. Also, there might be reduced blood sugar, depletion of alternative glucose stores, gluconeogenesis activity and lipid breakdown in the liver (Guliński, 2021).

In Intensive farm management decreased milk production, lethargy, and an empty-appearing abdomen are usually the first clinical signs of ketosis. Physical examination shows cows are afebrile and may be slightly dehydrated. Rumen motility is variable, being hyperactive in some cases and hypoactive in others. In many cases, there are no other physical abnormalities (Madreseh-Ghahfarokhi *et al*., 2018).

In some cases, CNS disturbances are also prevalent (nervous ketosis) neurological symptoms such as repeated self-licking, aggressive behaviour, odd head posture, bizarre behavior, and even blindness. These clinical signs occur in a minority of cases; however, because the disease is so common, encountering patients with these clinical signs is not unusual (Pietrzak *et al*., 2022).

5. Diagnosis of ketosis in Cattle

Ketosis can be diagnosed by measuring the amount of beta-hydroxybutyric acid (BHBA) in the blood or milk. Blood, milk, or urine samples from dairy cows can be analysed immediately on the farm using a cow-side analyser. Laboratory-based spectrophotometric assay (SA) of serum β-hydroxybutyrate (BHB) concentration is widely regarded as the standard method for diagnosing ketosis (Serrenho *et al*., 2022). Other laboratory-based methods such as Fourier transform infrared (FTIR) spectrometry, gas liquid chromatography, nuclear magnetic resonance (NMR) spectroscopy, and gas chromatography-mass spectrometry (GCMS) tests have been developed to measure BHBA, acetoacetate, and acetone in the serum or plasma. These methods are considered as gold standard diagnostic methods as these evaluate serum BHBA with threshold values exceeding 1.2 mmol/L (Aksoy *et al*., 2023).

Even after successful treatment, subclinical ketosis continues to negatively affect dairy cow productivity, making early detection essential. Laboratory based tests, Fourier transform infrared spectrometry measures concentration of milk βOHB and Ac that helps in the detection of SCK. Rapid field diagnostic methods, such as β-hydroxybutyrate (BHBA) testing, the milk fat-to-protein ratio (FPR), and milk BHB measurement, enable timely diagnosis and help minimise economic losses for farmers. Subclinical ketosis can be identified early during the postpartum period using convenient cow-side diagnostic tests (Cascone *et al*., 2022).

Urine, being a readily obtainable body fluid, is commonly used for the cow-side assessment of ketosis. One of the most frequently employed cow-side urine tests is the semi-quantitative urine dipstick, which detects acetoacetate (AcAc). In addition, nitroprusside tablets have been reported as a quantitative method for measuring urinary AcAc and are used for the on-farm diagnosis of ketosis. Cow-side milk tests for ketosis have a considerable advantage over both blood and urine tests for ease of milk collection and for assurance that all cows in the herd can be tested at the time of milking. The milk βOHB test strip is the most promising cow-side milk test for ketosis. Milk AcAc can be qualitatively measured by Nitroprusside powders. A study conducted by Geishauser *et al*, (2000) reported that milk AcAc could be measured semi-quantitatively by Pink test liquid. A dipstick designed for the measurement of milk βOHB also has been utilized for evaluating urine βOHB. The limitations of milk cow-side tests are that generally they are not as sensitive as urine tests in monitoring of ketosis (Ravi *et al*., 2019).

6. Treatment of Ketosis in Dairy Cows

Ketosis is an important metabolic disorder in lactating dairy cows that adversely affects animal health, milk production, and overall herd productivity. Prompt therapeutic intervention is essential to restore energy balance and minimize production losses. Intravenous administration of 50% dextrose is commonly used in severe cases, as it provides an immediate source of glucose and rapidly lowers circulating ketone body concentrations (McArt *et al*., 2012). Oral propylene glycol is another widely used treatment that acts as a glucogenic precursor, increasing blood glucose concentrations while reducing ketone body formation over several days (Murray *et al*., 2006). In selected cases, corticosteroids such as dexamethasone may be administered to stimulate gluconeogenesis, improve appetite, and enhance metabolic function, although their use is relatively limited. Supplementation with vitamin B12 may further support metabolic recovery, while electrolyte therapy and energy-dense diets rich in carbohydrates and fats help restore the negative energy balance by improving nutritional status. When ketosis is accompanied by inflammation, non-steroidal anti-inflammatory drugs (NSAIDs) may be administered to reduce inflammation and promote recovery (Ruboni *et al*., 2015). Although some cows may recover from ketosis without specific treatment, spontaneous recovery is generally slow and is associated with prolonged reductions in milk yield, leading to significant economic losses.

7. Prevention strategies of clinical ketosis

Prevention of clinical ketosis in dairy cows requires effective nutritional and management strategies during the transition period. Supplementation of diet containing at least 60% high-quality fresh or conserved roughage during early lactation is essential for maintaining rumen function, supporting feed intake, and meeting the increased energy and protein demands of high-producing cows. This is particularly important during winter, when homegrown conserved forages may not provide sufficient energy to meet the requirements of lactating cows. To promote rumen adaptation and reduce the risk of metabolic disorders, concentrate feeds should be introduced gradually approximately two weeks before calving. Likewise, dietary changes during early lactation should be made progressively to avoid digestive disturbances. Offering of highly palatable forage after calving, appropriate housing and careful management, helps to facilitate the transition from gestation to lactation, thereby reducing the incidence of clinical ketosis (Bystrom *et al*., 2002; Moorby *et al*., 2002). Prevention of clinical ketosis is generally more effective than treatment and primarily relies on sound transition cow management.

References

Brunner, N., Groeger, S., Raposo, J. C., Bruckmaier, R. M. and Gross, J. J. (2019). Prevalence of subclinical ketosis and production diseases in dairy cows in Central and South America, Africa, Asia, Australia, New Zealand, and Eastern Europe. *Translational Animal Science*, **3**(1):84–92.

Bystrom, S., Jonsson, S., and Martinsson, K. (2002). Organic versus conventional dairy farming studies from the Öjeby Project. In: Proceedings of the UK Organic Research 2002 Conference. Organic Centre Wales, Institute of Rural Studies, University of Wales Aberystwyth. pp: 179-184.

Cascone, G., Licitra, F., Stamilla, A., Amore, S., Dipasquale, M., Salonia, R. and Zecconi, A. (2022). Subclinical ketosis in dairy herds: Impact of early diagnosis and treatment. *Frontiers in Veterinary Science*, **9**:895468.

Emam, M. H., Elmaghawry, S. and Abdelaal, A. M. (2025). Transition period in dairy cows: Monitoring, challenges, and future perspectives. *Egyptian Journal of Veterinary Sciences*, **56**(11): 2849-2859.

Guliński, P. (2021). Ketone bodies–causes and effects of their increased presence in cows' body fluids: A review. *Veterinary World*, **14**(6): 1492.

Ha, S., Kang, S., Han, M., Lee, J., Chung, H., Oh, S. I. and Park, J. (2022). Predicting ketosis during the transition period in Holstein Friesian cows using hematological and serum biochemical parameters on the calving date. *Scientific Reports*, **12**(1): 853.

Madreseh-Ghahfarokhi, S., Dehghani-Samani, A. and Dehghani-Samani, A. (2018). Ketosis (acetonaemia) in dairy cattle farms: practical guide based on importance, diagnosis, prevention and treatments. *Indian Journal of Veterinary and Animal Sciences Research*, **7**(6): 299-302.

McArt, J.A.A., Nydam, D.V., Oetzel, G.R., Overton, T.R. and Ospina, P.A (2012). A field study of the effects of ketosis on production and health of dairy cows. *Journal of Dairy Science*, **95**(9):5056-5066.

Mooli, R. G. R. and Ramakrishnan, S. K. (2022). Emerging role of hepatic ketogenesis in fatty liver disease. *Frontiers in Physiology*, **13**: 9464274.

Moorby, J., Dewhurst, R., Evans, R. and Fishert, W. (2002). Effects of level of concentrate feeding during the second gestation of Holstein-Friesian dairy cows: Nitrogen balance plasma metabolites. *Journal of Dairy Science*, **85**(1):178-189.

Murray, R.D., Grieve, A.G., Ball, H.J and Perry, J.D. (2006). Propylene glycol as a treatment for ketosis in dairy cows. *Veterinary Record*, **159**(21):712-714.

Pietrzak, D., Kasperek, K., Rękawek, P. and Piątkowska-Chmiel, I. (2022). The therapeutic role of ketogenic diet in neurological disorders. *Nutrients*, **14**(9):1952.

Ravi, R., Vijayakuma, G., Mohanambal, K., Sivaraman, S. and Reddy, B. S. (2019). Cow side tests for detection of ketosis in dairy cows. *Indian Veterinary Journal*, **96**:71-72.

Sammad, A., Khan, M. Z., Abbas, Z., Hu, L., Ullah, Q., Wang, Y. and Wang, Y. (2022). Major nutritional metabolic alterations influencing the reproductive system of postpartum dairy cows. *Metabolites*, **12**(1): 60.

Saradhi, K. P., Sandilya, A., Sravya, R. N. S. and Vijayalakshmi, P. (2024). Ketosis in dairy cattle: A comprehensive review. *International Journal of Advanced Biochemistry Research*, **8**(12), 1008-1015.

Satoła, A. and Bauer, E. A. (2021). Predicting subclinical ketosis in dairy cows using machine learning techniques. *Animals*, **11**(7):2131.

Tufarelli, V., Puvača, N., Glamočić, D., Pugliese, G. and Colonna, M. A. (2024). The most important metabolic diseases in dairy cattle during the transition period. *Animals*, **14**(5):816.

Wang, X., Li, X., Zhao, C., Hu, P., Chen, H., Liu, Z. and Wang, Z. (2012). Correlation between composition of the bacterial community and concentration of volatile fatty acids in the rumen during the transition period and ketosis in dairy cows. *Applied and Environmental Microbiology*, **78**(7): 2386-2392.

Zhang, G. and Ametaj, B. N. (2020). Ketosis an old story under a new approach. *Dairy*, **1**(1): 5.

Zhang, Y., Wang, C., Khan, M. Z., Ju, Z. and Huang, J. (2025). Current Understanding of Bovine Ketosis: From Molecular Basis to Farm-Level Management. *Animals*, **15**(24):3644.

Aksoy K, Deniz A, Metin M, Tuna GE. (2023). Validation of a portable beta-hydroxybutyric acid analyser for the diagnosis of subclinical ketosis in dairy cows. Kocatepe Veterinary Journal. **16**(3):317-325.

Riboni, M. V., Meier, S., Priest, N. V., Burke, C. R., Kay, J. K., McDougall, S., & Loor, J. J. (2015). Adipose and liver gene expression profiles in response to treatment with a nonsteroidal antiinflammatory drug after calving in grazing dairy cows. *Journal of Dairy Science*, **98**(5): 3079-3085.

Geishauser, T., Leslie, K., Tenhag, J., & Bashiri, A. (2000). Evaluation of eight cow-side ketone tests in milk for detection of subclinical ketosis in dairy cows. *Journal of dairy science*, **83**(2): 296-299.