Vitamine D bij rundvee

Euregio Laboratory Services |

Key points

- vitamin D status of animals is reliably indicated by the concentration of the 25-hydroxycholecalciferol metabolite in serum or plasma
- 25-hydroxycholecalciferol status in plasma is linearly correlated to daily summer pasture time in cattle
- serum 25-hydroxycholecalciferol concentration of 75 nmol/l proposed as a lower threshold for sufficiency
- mean serum 25-hydroxycholecalciferol concentration in vitamin D supplemented dairy cattle in the USA was 170±55 nmol/l with the majority of samples between 100 and 250 nmol/l
- parity, age, and season were not associated with variation in serum 25(OH)D concentrations
- cows supplemented with 30,000 to 50,000 IU of vitamin D_3/day showed an average serum 25-hydroxycholecalciferol concentration near or above 175 nmol/l when at 100 to 300 Days in milk (regardless of season or housing)

Algemeen: Uit de voeding of de huid afkomstig vitamine D2 en vitamine D3 (=cholecalciferol of calciol) wordt in de dunne darm geresorbeerd, waarna het ofwel in het vetweefsel opgeslagen wordt, ofwel in de lever tot 25(OH)Vitamine D3 wordt gehydroxyleerd. Vitamine D circuleert via het bloed gebonden aan het zogenoemde "vitamine D-bindend proteïne" (VDBP). Op deze wijze wordt het ook naar de lever getransporteerd. Vooral in de lever, maar ook in een aantal andere lichaamsweefsels, wordt vitamine D3 (en D2) via het enzym vitamine D3-25-hydroxylase omgezet in calcidiol (25-hydroxyvitamine D of kortweg 25-OH D3). Deze metaboliet van vitamine D heeft slechts een geringe biologische activiteit. Calcidiol wordt uiteindelijk in de nieren onder invloed van 25-hydroxyvitamine D3-1-alpha-hydroxylase omgezet in het actieve hormoon calcitriol (1α,25-dihydroxycholecalciferol).

Calciol (of cholecalciferol) → calcidiol → calcitriol

Cattle obtain vitamin D by ingestion or cutaneous exposure to UV light. Dairy cattle diets are frequently supplemented with vitamin D to compensate for limited sun exposure or during times of increased metabolic demands, such as the periparturient period, to maintain calcium homeostasis (Holcombe et al. 2018).
The vitamin D status of animals is reliably indicated by the concentration of the 25-hydroxyvitamin D [25(OH)D] metabolite in serum or plasma, with a concentration of 75 nmol/l proposed as a lower threshold for sufficiency (Nelson et al. 2016).
In vitro studies with skin samples or pure precursors of cholecalciferol indicated that cholecalciferol synthesis during UV light exposure is a non-linear process. However, in vitro studies indicate nothing about the relationship between sunlight exposure and physiological

cholecalciferol status of living organisms. Due to the lack of cholecalciferol in plant material, this relationship is important for herbivores including domestic cattle, particularly in organic agriculture, because the use of synthetic additives, like cholecalciferol, is restricted in order to fulfil the principles of sustainable organic production. Animals allowed 15, 30 or 75 min of daily access to pasture showed a declining linear relationship between plasma 25(OH)D_3 and sampling day in contrast to animals allowed 150 or 300 min of pasture access which showed linear increasing plasma 25(OH)D_3 status. As such, 25-hydroxycholecalciferol status in plasma is linearly correlated to daily summer pasture time in cattle. Furthermore, determined from the slopes of 25(OH)D_3 concentration curves within treatments, breakeven for maintaining the initial 25(OH)D_3 status of 45 nmol/l was 90 min pasture access per d during summer at 56°N (Hymøller and Jensen 2012).
To determine how serum vitamin D concentrations of dairy cows change with season, age, parity, and stage of lactation clinically healthy cows (n = 183) from 5 commercial dairies were enrolled in the study. Serum samples were collected at dry off, within 7 days of entering the close-up group, and within 7 days after calving. Vitamin D status was determined by measuring serum 25-hydroxyvitamin D [25(OH)D] by radioimmunoassay. Bivariable analysis indicated that parity, age, and season were not associated with serum 25(OH)D concentrations. Sample period affected 25(OH)D concentrations, with the highest 25(OH)D levels at dry off (248±4.7 nmol/l) followed by close up (235±5.3 nmol/l), with the lowest levels at 7 days after calving (207±4.3 nmol/l). These data showed a large depletion of 25(OH)D in dairy cattle postpartum compared with late prepartum, although the biological significance of this change in these healthy cattle is unclear (Holcombe et al. 2018).
To determine the typical serum 25(OH)D concentrations of dairy cattle across various dairy operations 702 samples collected from cows across various stages of lactation, housing systems, and locations in the USA revealed 170±55 nmol/l (mean ± standard deviation), with the majority of samples between 100 and 250 nmol/l. Most of the 12 herds surveyed supplemented cows with 30,000 to 50,000 IU of vitamin D_3/day, and average serum 25(OH)D of cows at 100 to 300 DIM in each of those herds was near or above 175 nmol/l regardless of season or housing. In contrast, average serum 25(OH)D of a herd supplementing with 20,000 IU/day was 105±38 nmol/l, with 22% below 75 nmol/l. Cows in early lactation (0 to 30 days in milk) also had lower serum 25(OH)D than did mid- to late-lactation cows (143±43 vs. 178±50 nmol/l, respectively). Serum 25(OH)D of yearling heifers receiving 11,000 to 12,000 IU of vitamin D_3/day was near that of cows at 190±38 nmol/l. Serum 25(OH)D concentrations of calves, on the other hand, was 38±28 nmol/l at birth and remained near or below 38 nmol/l through one month of age if they were fed pasteurized waste milk with little to no summer (Nelson et al. 2016).

Footnote 1: vitamin D3 (oral bolus of 1.0×10^7 IU) given after vitamin D2 (oral bolus of also 1.0×10^7 IU) is less efficient at increasing the plasma status of 25(OH)D(3) than vitamin D3 given without previous vitamin D2 administration (Hymøller and Jensen 2011).

Footnote 2: overall feeding 25-OH vitamin D with a negative dietary cation-anion difference diet increased vitamin D status of the cow and her newborn calf but had minimal effects on calcium status and did not have positive effects on the incidence of hypocalcemia (Weiss et al. 2015).

References

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