**Application**

**Temporal trends in blood analytes can provide a better understanding of the dairy cows’ transition period, and facilitate the identification of adaptation challenges faced by spring-calving pasture-based dairy cows.**

**Introduction**

**During the transition period the dairy cow progresses from being dry and pregnant to lactating and not pregnant. This period comes with a multitude of physiological changes which challenge cows’ homeorhesis and homeostasis and often evolve into mineral, energy and/or inflammatory imbalances, which decrease production and reproductive success (Hostens et al., 2012; Roche et al., 2018). Much research has focused on monitoring and preventing these imbalances in confined cows, to which blood analyte determination has been at the forefront. Less of this research has been completed with pasture-based dairy cows. Hence, the main objective of this study was to determine the temporal pattern of serum concentrations of minerals (Ca, P, Mg), energy balance markers [non-esterified fatty acids (NEFA) and β-hydroxybutyrate (BHB)] and inflammatory markers (haptoglobin) during the transition period in spring-calving pasture-based dairy cows.**

**Materials and Methods**

**Five-hundred and 63 cows [mean parity ± standard deviation (SD) = 4 ± 2.3] of predominately Holstein genetics [mean % Holstein-Friesian in cows’ breed (Interquartile range) = 86 (78 to 100%)] from 27 spring-calving pasture-based dairy herds in the Republic of Ireland were enrolled in this study (range = 14 – 25 cows/farm). Blood samples were collected from the coccygeal vessels 3 times within the study cows’ transition period (mean ± SD days relative to calving): -8 ± 7 days, 12 ± 6 days and 25 ± 7 days. Serum concentrations of Ca, P, Mg, BHB and NEFA were determined using an automated wet chemistry analyser and haptoglobin concentration was determined using a colorimetric assay as described by Brady et al. (2019).**

**A multivariate adaptive regression splines model (earth package in R; Milborrow et al., 2024) was used to identify breakpoints in the slope of blood analyte concentrations by day relative to calving. Slopes driven by consecutive days with ≤6 observations per day are not reported. For each blood analyte, 1,000 bootstrap observations were generated by resampling with replacement from the original data. The mean predicted blood analyte concentration at each breakpoint was calculated from the distribution of the bootstrap predictions.**

**Results**

**Regarding minerals, Ca concentration remained stable until 7 days prepartum (2.01 mmol/L), whereby it decreased reaching a nadir of 1.91 mmol/L at 2 days postpartum, increasing from there up to 2.13 mmol/L at 33 days postpartum. Phosphorus concentration remained stable until 6 days prepartum (1.88 mmol/L), decreased from there until 11 days postpartum (1.56 mmol/L), and from there it increased reaching 1.75 mmol/L by 43 days postpartum. Magnesium concentration remained stable until 8 days postpartum (0.81 mmol/L), whereby it began increasing reaching 1.08 mmol/L by 43 days postpartum.**

**Regarding energy balance markers, concentration of NEFA remained stable until 8 days prepartum (0.27 mmol/L), and increased thereafter until 11 days postpartum (0.91 mmol/L), at which NEFA concentration began decreasing reaching 0.24 mmol/L by 43 days postpartum. Concentration of BHB remained stable until 17 days postpartum (0.66 mmol/L), whereby it began decreasing reaching 0.64 mmol/L by 43 days postpartum.**

**Last, concentration of haptoglobin increased until 6 days postpartum (0.25 g/L), whereby it remained stable until 43 days postpartum.**

**Conclusions**

**Breakpoints were identified in the temporal concentration trends of serum minerals, energy balance markers and inflammatory markers assessed in this study. Serum Ca and P concentrations, followed similar and physiologically expected dynamics, and Mg concentration was kept within reference values. However, despite of following a physiologically expected dynamic, mean values for serum Ca concentration suggest a Ca imbalance in spring-calving pasture-based dairy cows. Serum NEFA concentration suggests body fat mobilization beginning within the first 2 weeks postpartum, while the same could not be inferred from observed serum BHB concentration. And, Haptoglobin concentration breakpoint was seen later in the days postpartum than expected.**

**Our findings call for a better understanding of serum Ca balance during the transition period and inflammation insults in the postpartum period in spring-calving pasture-based dairy cows.**

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**References**

**Bates, D., M. Maechler, B. Bolker, S. Walker, R.H.B. Christensen, H. Singmann, B. Dai, F. Scheipl, G. Grothendieck, P. Green, J. Fox, A. Bauer, P.N. Krivitsky, E. Tanaka, and M. Jagan. 2024. Package “lme4” Reference Manual.**

**Brady, N., E.L. O’Reilly, C. McComb, A.I. Macrae, and P.D. Eckersall. 2019. An immunoturbidimetric assay for bovine haptoglobin. Comp. Clin. Path. 28:21–27. doi:10.1007/s00580-018-2863-6.**

**Milborrow, S., T. Hastie, R. Tibshirani, A. Miller, and T. Lumley. 2024. Multivariate Adaptive Regression Splines 19. doi:10.1214/aos/1176347963.**

**Hostens, M., J. Ehrlich, B. Van Ranst, and G. Opsomer. 2012. On-farm evaluation of the effect of metabolic diseases on the shape of the lactation curve in dairy cows through the MilkBot lactation model. J. Dairy Sci. 95:2988–3007. doi:https://doi.org/10.3168/jds.2011-4791.**

**Roche, J.R., C.R. Burke, M.A. Crookenden, A. Heiser, J.L. Loor, S. Meier, M.D. Mitchell, C.V.C. Phyn, and S.A. Turner. 2018. Fertility and the transition dairy cow. Reprod. Fertil. Dev. 30:85–100. doi:10.1071/RD17412.**