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Feeding for optimal fertility: screening of the β-carotene and vitamin E status in the Flemish dairy industry – Effects of lactation status, season and farm type

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Dairy cow subfertility due to postpartum metabolic stress has been clearly described. An important recognized mechanism responsible for reduced oocyte and embryo quality is oxidative stress. Therefore, antioxidants such as β-carotene (bC) and vitamin E (VitE) can be a promising solution to protect oocytes and embryos under metabolically compromised conditions. We recently showed that strategically supplied bC can improve antioxidant concentrations in the oocyte's micro-environment during negative energy balance (NEB). Unfortunately, with the increased use of forages, antioxidant intake from fresh feed decreased steeply. Moreover, most recent vitamin supplementation guidelines date from 2001 (NRC) and with the rapidly changing dairy industry, there is a need to re-evaluate optimal vitamin nutrition to support fertility. Consequently, the aim of this study was to investigate the bC and VitE status of the Flemish dairy cow and to unravel the possible effect of lactation status, season and farm type ((zero-)grazing) on blood bC and VitE concentrations.

Seven grazing and 7 zero-grazing dairy farms were visited during autumn (AUT, after the grazing season), spring (SPR, before release on pasture) and summer (SUM, when temperature rises up to 32°C and cows might be grazing). During each visit, blood was randomly sampled from 5 dry cows (DRY, 2-4w before calving), 5 cows in early lactation (EARLY LACT, 0-3w after calving) and 5 cows in late lactation (LATE LACT, at time of AI), and analyzed on bC and VitE. Data were statistically analyzed using linear mixed models in which the 3 covariates (lactation status, season and farm type) as well as their interactions were included. *P*-values<0.05 are considered significantly different.

Significant interactions were found between all 3 covariates for bC and between type of farm and lactation status for VitE. Within every type of farm and in each season, bC is significantly lower in EARLY LACT compared with LATE LACT (minimum difference of -35.2% in zero-grazing farms in SPR, maximum difference of -44.9% in zero-grazing farms in AUT). Also VitE levels are significantly lower in EARLY LACT compared with LATE LACT in both grazing (-42.0%) and zero-grazing farms (-43.4%). Season had no effect on VitE concentrations, but bC levels in cows on grazing farms were significantly lower in SUM compared with AUT (-38.0% in DRY; -33.4% in LATE LACT; -30.2 % in EARLY LACT). Interestingly, we observed that DRY cows on grazing farms had higher levels of bC (114.6% in AUT, 24.7% in SUM, not different in SPR) and VitE (32.4 %) compared with zero-grazing farms.

In conclusion, NEB during early lactation has a negative impact on bC and VitE levels. Unfortunately, being housed on a pasture based farm only improves blood bC and VitE during the dry period. Finally, heat stress might reduce bC, but not VitE during summer. These findings can be of importance to re-evaluate nutritional strategies to feed for optimal dairy cow fertility.