Effect of phosphorus intake during the transition period on plasma phosphorus content and hypocalcemia in dairy cows

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Introduction In early lactation, high producing cows frequently suffer from negative energy and mineral balances including a negative phosphorus balance (Grünberg et al., 2014; Goff, 2004). Farmers and veterinarians in the Netherlands worry that due to legislative pressure to reduce dietary phosphorus (P), P intake in early lactation may be insufficient and will increase the risk of milk fever-like health problems. The objective of this study is to observe the effect of reduced P intake in dairy cows in the first 8 weeks postpartum on P and calcium (Ca) content in blood plasma and clinical hypocalcemia. Interaction effects of feeding a dry cow diet at or above P requirements on performance after calving are also investigated.

Materials and Methods Sixty multiparous dairy cows (HF) were, approximately 6 weeks before calving, randomly allocated to either a dry cow ration with a P content commonly encountered in practice in the Netherlands (i.e. Dry Period Normal (DP-N), 3.7 g P/kg DM) or a reduced P content, matching their calculated P requirements (CVB, 2005; i.e. Dry Period Required (DP-R), 2.0 g P/kg DM). After calving cows from each group were subjected to a ration containing either a normal dietary P content (i.e. Lactation Normal (LAC-N), 3.7 g P/kg DM) or a ration below calculated P requirements (i.e. Lactation Low (LAC-L), 2.6 g P/kg DM until 8 weeks postpartum, in a 2 × 2 factorial design.
The cows received a roughage mixture *ad libitum* and concentrates were fed individually by means of transponder-controlled concentrate feeders. Cows were milked twice daily and throughout the experiment animal health was monitored daily. Blood samples were taken 1, 2, 3, 7, 14, 21, 28 and 56 days after calving. Data were statistically analyzed according to the following model: $Y_{ij} = \mu + DP\text{-}P_i + LAC\text{-}P_j + (DP\text{-}P \times LAC\text{-}P)_{ij} + e_{ij}$; where Y_{ij} = repeated measure of the response variable, μ = overall mean, $DP\text{-}P_i$ = Dietary P during the dry period (DP) (i = N or R), $LAC\text{-}P_j$ = Dietary P during lactation (j = N or R), $(DP\text{-}P \times LAC\text{-}P)_{ij}$= interaction term between DP-P and LAC-P and e_{ij} = residual error. A cow with 2 out of 3 clinical signs (i.e. sternal or lateral recumbency, cold extremities, no rumen contractions) was considered a case of clinical milk fever; subclinical milk fever was defined as a blood calcium concentration lower than 2.0 mmol/l (Reinhardt et.al., 2010).

Results The incidence of clinical and subclinical hypocalcaemia is shown in Table 1. Phosphorus and Ca content in blood plasma were significantly affected by dietary P content of the lactation diet: LAC-L group showed lower P content in blood plasma than LAC-N group ($P<0.05$). Phosphorus content in blood is lowest at day 7 postpartum in cows fed LAC-L (Figure 1). Calcium content in blood plasma varied less but was significantly higher in group LAC-L ($P<0.05$). There was no interaction between dry cow diet and lactation diet; however, cows fed a reduced P diet during the dry period (DP-R) had higher plasma P and Ca concentrations postpartum compared with DP-N ($P<0.05$).

Table 1 Number of cows with (sub-) clinical hypocalcemia

Dietary P during dry period	Normal		Required	
Dietary P during lactation	Normal	Low	Normal	Low
No of cases / no of total cows				
clinical hypocalcemia	6/15	6/15	4/15	4/15
Plasma Ca < 2.0 mM first week postpartum	14/15	13/15	12/15	7/15
Plasma Ca < 2.0 mM weeks 2-8	3/15	2/15	0/15	1/15

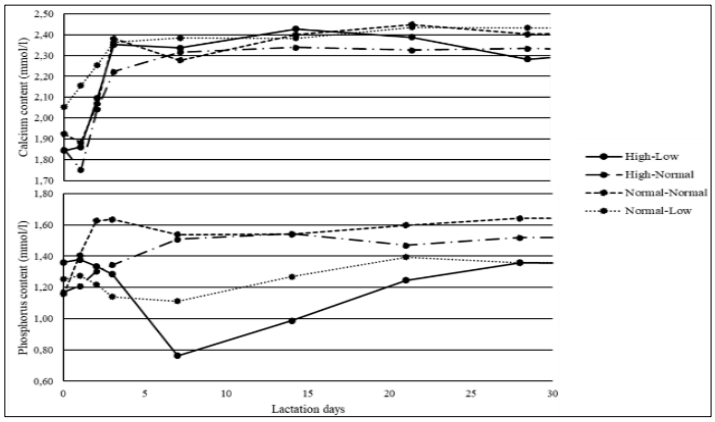

Figure 1 Means phosphorus and calcium content in blood plasma from calving to 56 days in lactation of cows receiving High or required levels of P during the dry period and normal or reduced levels of P during lactation

Conclusions Feeding below P requirements during the first 8 weeks of lactation does not seem to increase the incidence of clinical milk fever; it reduces plasma P content but increases plasma Ca, likely by increased bone mobilization. Dietary P content of the dry cow ration also affects plasma content postpartum. When feeding at ~185% of calculated dry cow P requirements, postpartum plasma P and Ca content are reduced compared to a diet at P requirements.

References

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