

Effect of continuous milking during the dry period on milk cholesterol levels and expression of key genes in dairy cows

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Introduction

Cholesterol is a crucial molecule for life with a fine level regulation in the mammalian organism and with a significant role on the developing of cardiovascular disease in humans. As milk and dairy products are the second principal source of cholesterol in human modern diet, our research during the last years has focussed on its reduction via feeding, management or genetic selection strategies. The objective of these experiments was to understand the effects of the absence of dry period on bovine cholesterol metabolism and to test its potential application for reducing milk cholesterol levels.

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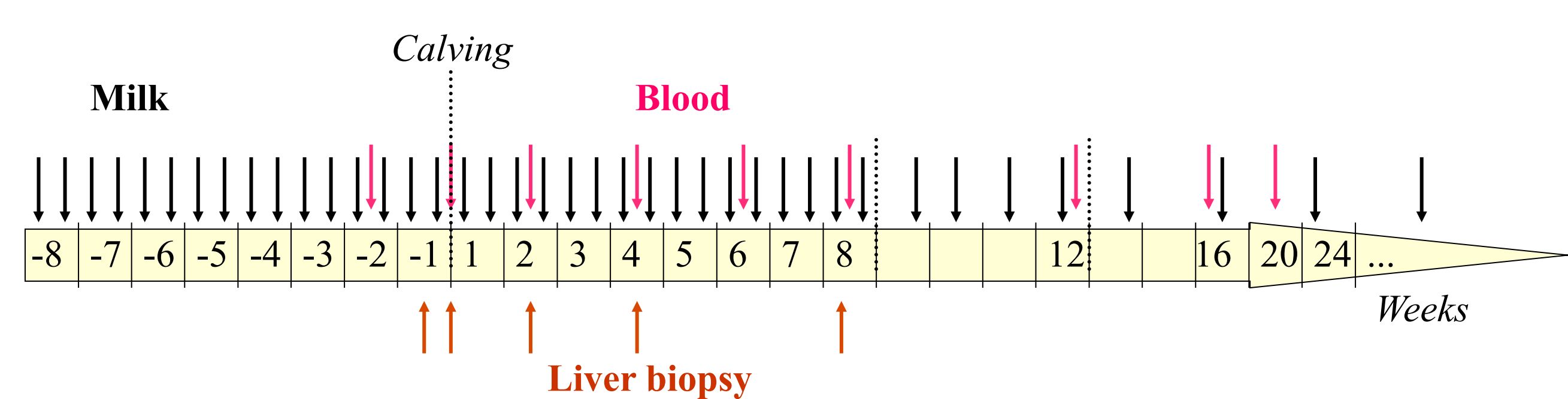
Materials and Methods

24 multiparous Brown Swiss cows

Two experimental groups:

- Control (C): dry-off period 56 days prior to calving, milked twice per day afterwards
- Continuous milking (CM): absence of dry-off period, milked twice per day also prior to calving

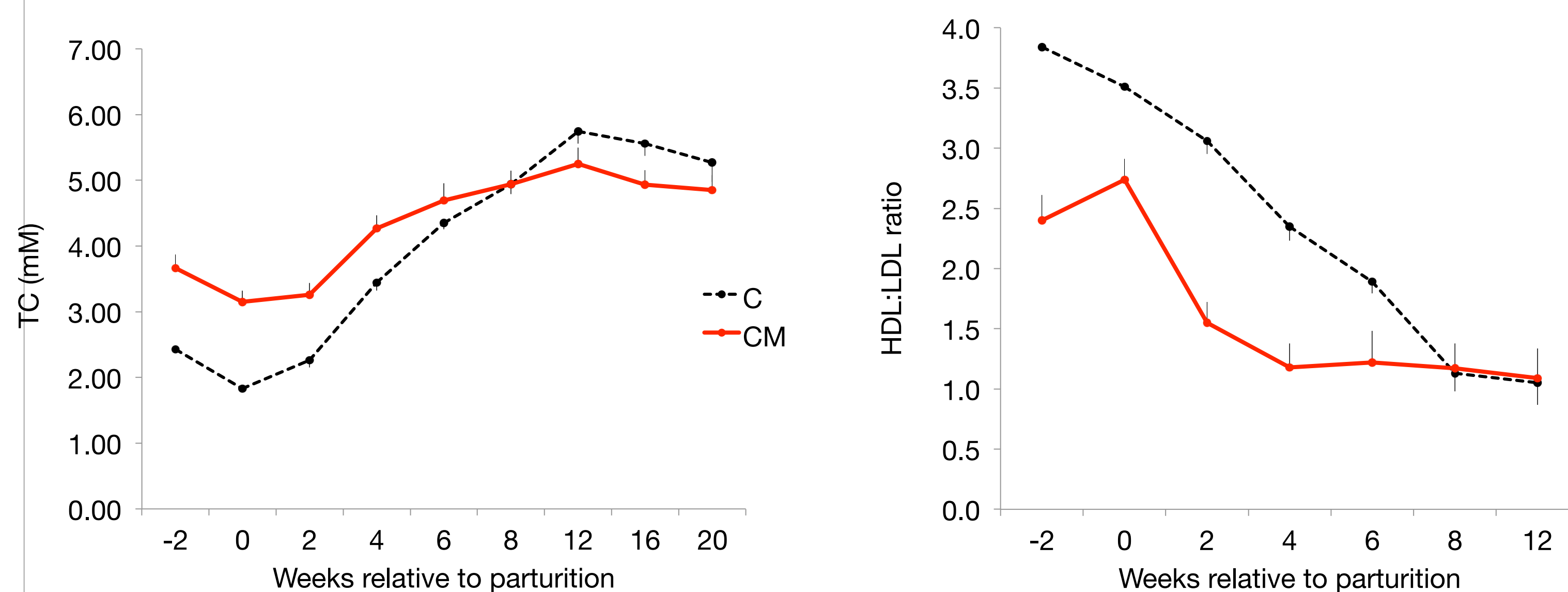
Obtained samples:



Results

Blood cholesterol levels

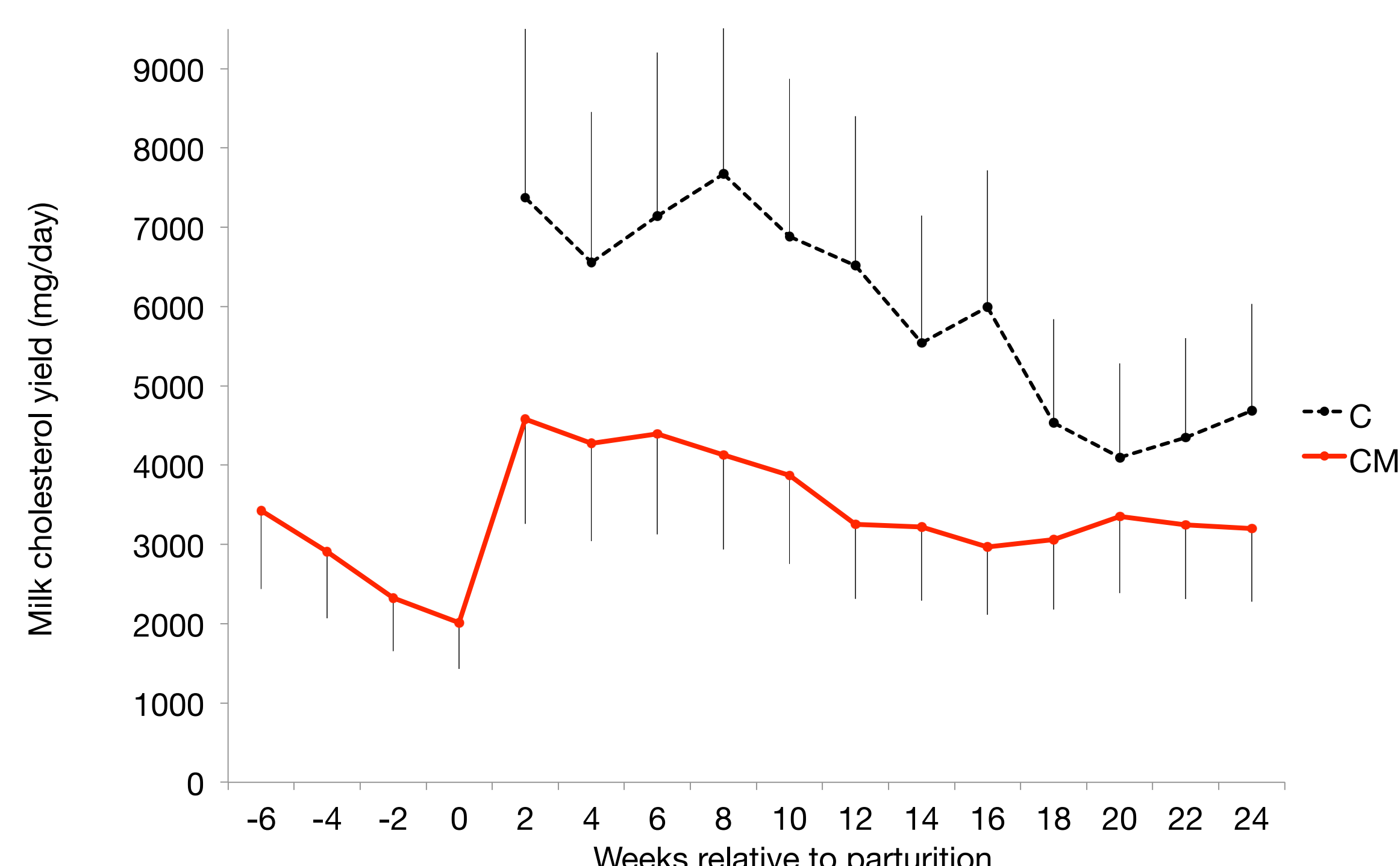
Animals on the CM group presented a significantly lower increase of blood cholesterol levels (TC) after parturition in comparison to the much more intense variation range of the C group, in which TC levels were 3-fold higher at week 12 compared to the basal situation at parturition. TC concentration is a valuable marker of fat mobilization and metabolic balance. The observed results were in concordance with the fact that no animal from the CM group suffered from ketosis or metabolic imbalance during the peripartal period.



As can be observed in the figure, the extreme mobilization of TC after parturition occurs on the basis of high density lipoprotein cholesterol (HDL). Its ratio to low density lipoprotein cholesterol (LDL) is around 1:1 on a basal status and increases up to 1:4 at stages of high cholesterol mobilization.

Milk cholesterol levels

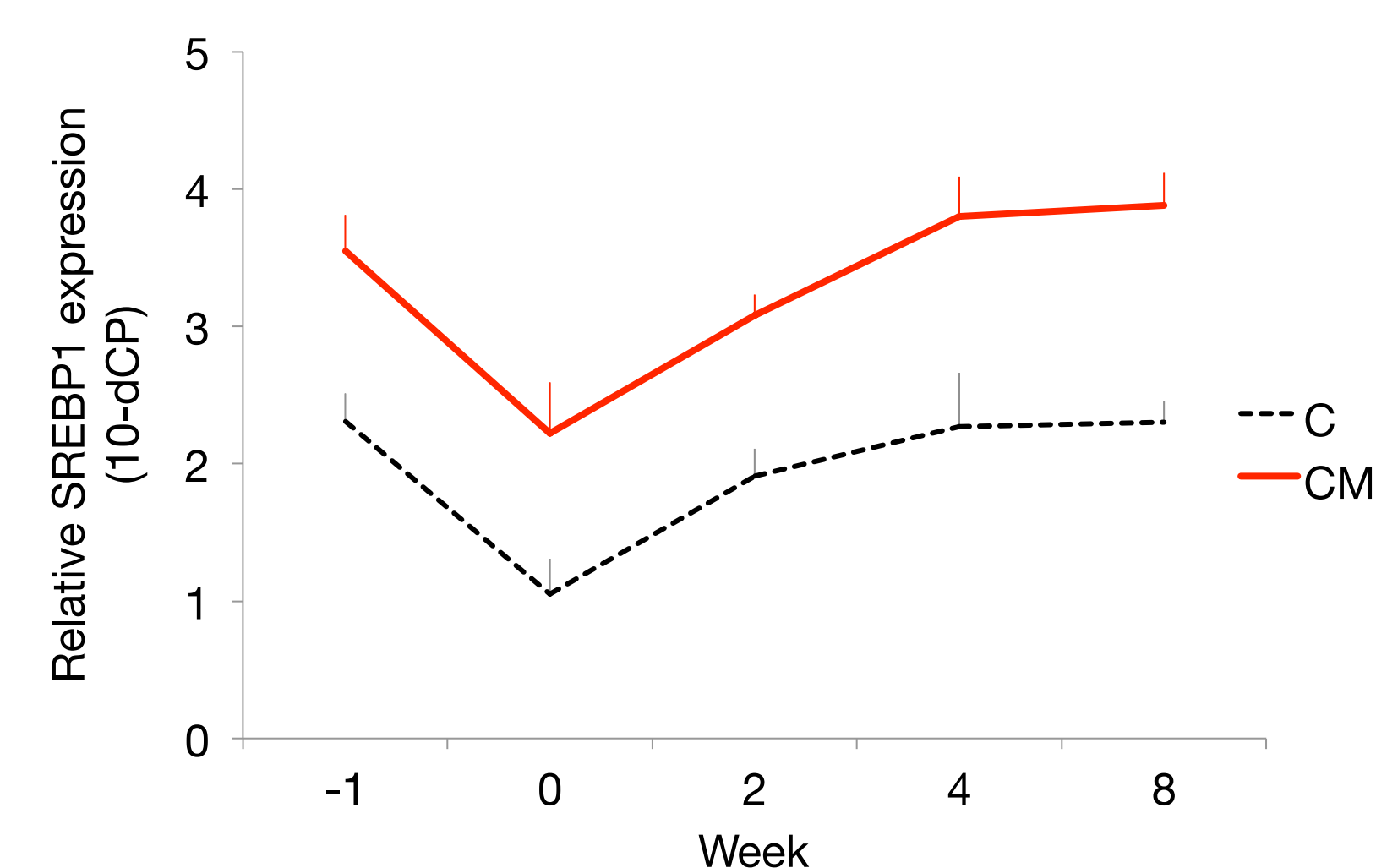
As observed in fig. 3, the suppression of dry period between two lactations resulted on a drastic reduction of milk cholesterol levels ($p < 0.01$) compared to C group. Individuals on the CM group presented very stable cholesterol levels from week 2 of lactation onwards, compared to the C group in which the levels at the beginning of lactation are almost 100% higher than those at the final weeks of the cycle.



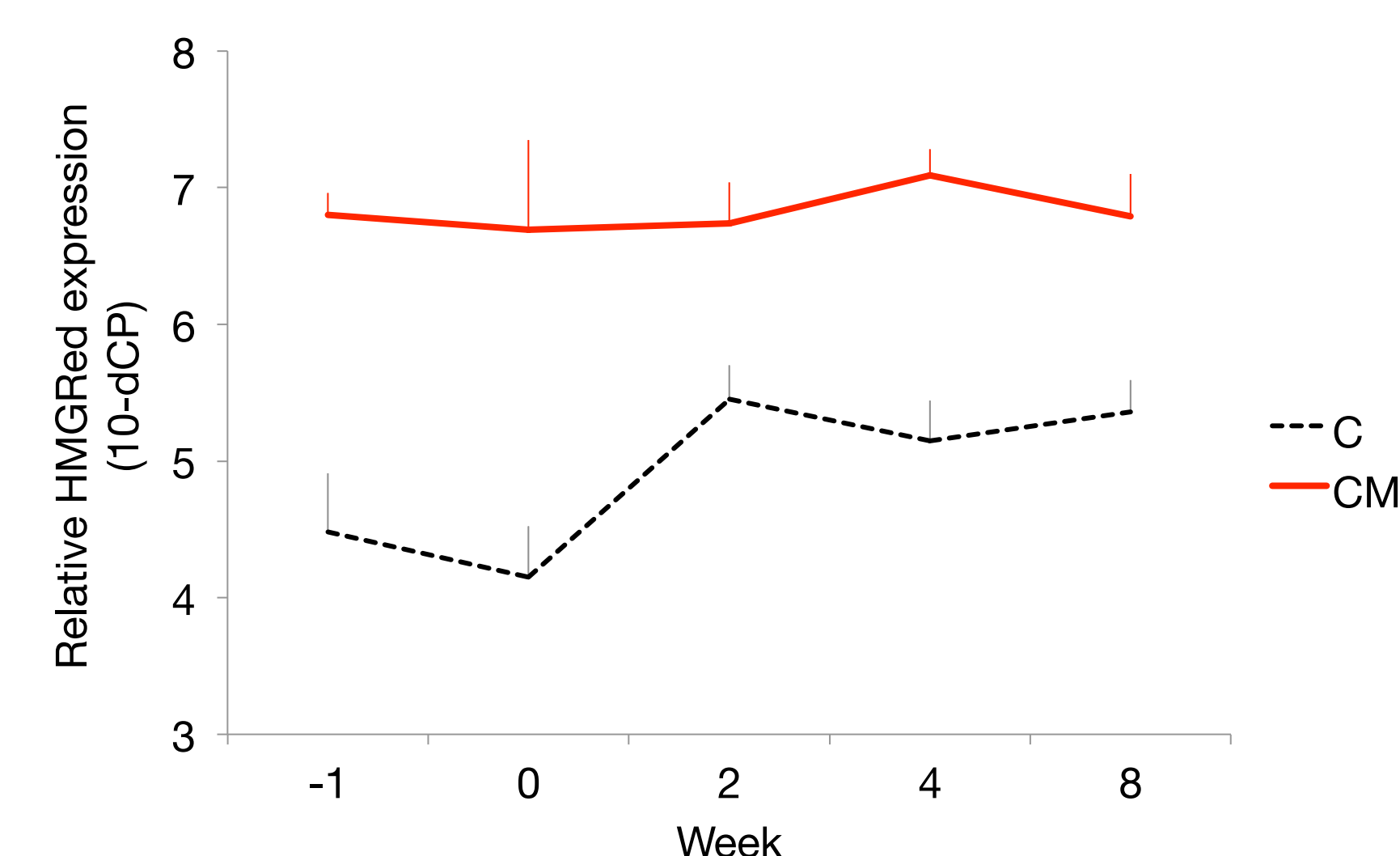
Gene expression

The liver expression of two groups of candidate genes (cholesterol synthesis and gene expression regulation related with fat metabolism) was studied. An example of each is presented:

- The expression of the sterol regulatory binding protein 1 (SREBP1) was significantly higher ($p < 0.01$) on the CM group compared to the C group during the whole lactation period and presented a similar variation path for both groups, as an image of the central role of this gene.



- The expression of HMGCoA Reductase, the rate limiting enzyme in the cholesterol synthesis pathway presented remarkable similarities to the blood cholesterol level variation: whereas it increased drastically immediately after parturition for the C group, its expression levels remained unchanged during the whole cycle for the CM group.



Conclusions

The suppression of the dry period between two lactations resulted in:

- Less milk cholesterol
- Higher stability of blood cholesterol levels and less incidence of ketosis and metabolic imbalance
- Higher expression levels of candidate genes. The expression of the enzymes of the cholesterol synthesis was maintained constant and not suppressed during the peripartal period, as occurred for the control group