# The dairy cow performances can be affected by inflammations occurring around calving

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Take home message: acute phase protein changes around calving are markers of higher risk of lower performance (included fertility)
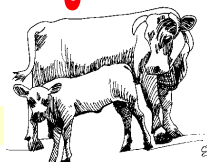
Introduction

➢ Transition period is the crucial time to optimise milk yield, health and fertility in dairy cows (Drackley, 1999).

➢ In fact, calving is quite often forwarded or followed by inflammatory phenomena (Cappa et al., 1989; Trevisi et al., 2001) that not always are associated to clinical symptoms (infections or not).

➢ These inflammatory conditions can be simply diagnosed by some specific blood changes, namely by positive or negative acute phase proteins (APP), and some of these markers seem well related to the performance of lactating cows

Aim

To evaluate effects of inflammation phenomena **around calving** on metabolic profile, BCS, milk yield, health status and fertility in dairy cows

To define the blood markers to predict fertility in the actual lactation.

Materials & Methods

Animals: 178 Holstein dairy cows of 6 commercial herds, during transition period

Individual controls:

➢ blood profile and BCS evaluation: –7, 3 (0 for BCS), 14, 28 days from calving

➢ milk yield: 7, 14, 28 DIM

➢ any health problem and insemination

Statistical evaluation:

✓ cows with drug treatments around peripartum were excluded (49)

✓ the remaining (129: 7 PR & 122 PL) were used to calculate a Liver Function Index (LFI) that include either plasma albumin, lipoproteins (cholesterol) and bilirubin changes between 3th (V3) to 28th (V28) DIM, standardized according to the optimal pattern of changes of the 3 parameters, obtained from healthy cows at the same DIM

✓ Step 1: albumin (Alb-I) and cholesterol (Chol-I) index = 50% V3 + 50% (V28-V3)

bilirubin (Bil-I) index = 67% V3 + 33% (V3-V28)

✓ Step 2: standardization of partial indices, according to means & SD of "healthy" cow

LFI = (Alb-I – 17,71)/1,08 + (Chol-I –2,57)/0,43 – (Bil-I –6,08)/2,17

✓ According to LFI, data were retrospectively grouped in quartiles: **LO-LFI**=lower (6 PR; 26 PL), **INLO-LFI**=lower intermediate (1 PR; 32PL), **INUP-LFI**=upper intermediate (32 PL), **UP-LFI**=upper (32 PL),

✓ Analysis of repeated measures (PROC MIXED of SAS) Model: cow, group, DIM, group x DIM

Results

Health problems: during first 30 DIM, 26.3% of cows suffered of some problem (of whom about ¼ more than one pathology).

The more frequent problems were: lameness, metritis & retained placenta (11, 7 & 6 cases respectively).

LO showed the highest frequency of clinical problems: 53.1% vs 39.4, 18.8 & 28.1% of INLO, INUP & and UP respectively.

Milk yield & fertility: higher in UP vs LO groups (fig. 1 & tab.1)

BCS: at calving was similar between groups (2.80 points), but body losses at 28th DIM were higher in LO vs UP group (-0.53 vs –0.38 points; P<0.06)
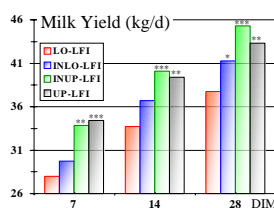

Figure 1 – Milk Yield in the 1st month of lactation

Table 1 – Fertility indices in lower (LO), lower and upper intermediate (INLO, INUP) and upper (UP) quartile of LFI.

Indices	Groups LO-LFI	INLO-LFI	INUP-LFI	UP-LFI
PFS	34.0	30.0	38.0	44.0
DO#	123.47±66.31	124.91±59.37	113.01±57.89	100.72±57.02
NSC#	2.17±1.68	2.21±1.47	2.06±1.43	1.58±1.02
% culled	19.0	9.0	0.0	16.0
FSI	23.20	29.66	55.44	61.13

Legend: # Normalized data

PFS (% Pregnant to First Service); IFS (Interval calving to 1st service); NSC (Number of Services per Conception); DO (Days Open); FSI (Fertility Status Index) = (PFS/NSC) – (DO - 125) – (% culled – 25)
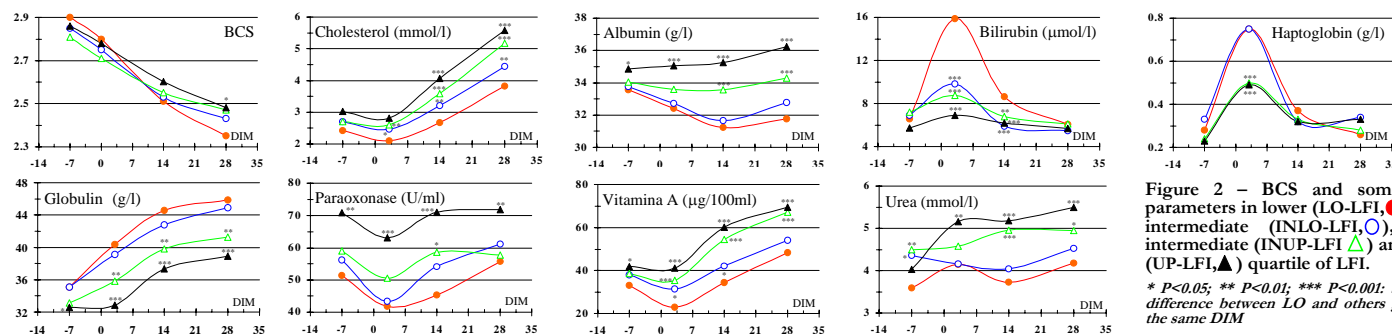

Figure 2 – BCS and some blood parameters in lower (LO-LFI,●), lower intermediate (INLO-LFI,○), upper intermediate (INUP-LFI △) and upper (UP-LFI,▲) quartile of LFI.

* P<0.05; ** P<0.01; *** P<0.001: significant difference between LO and others groups, at the same DIM

❖ *According to the criteria used to estimate LFI index, cholesterol (=lipoprotein), albumin and bilirubin* (only at 3rd & 14th DIM) *significantly discriminate the 4 groups* (figure 2).

❖ *+APP showed the highest values in LO and INLO groups*: in some cases only around calving (haptoglobin, figure 2) in others till 28th DIM (globulin – figure 2 - and ceruloplasmin; P<0.01). In addition, blood Ca and Zn (figure 2) - markedly reduced during inflammation - showed the more marked reduction around calving in LO and INLO groups.

❖ *-APP* (Vitamin A = Retinol Binding Protein and Paraoxonase) *had showed similar patterns of the cholesterol in the 4 groups* (figure 2). *Interestingly, all these differences are begun before calving and are maintained or grown during first 28 DIM* (P<0.05 between LO and UP groups).

❖ *UP vs LO showed higher values of glucose immediately before and after calving* (P<0.001). On the contrary, *NEFA & βHOB were lower in UP vs LO* (P<0.001 at 3rd DIM). *Often INLO and INUP showed intermediate values.*

❖ *UP* (and also INUP from 14th DIM) *exhibited significant higher value of urea since 3rd DIM vs LO group* (P<0.01);

❖ *Finally, LO vs UP group showed higher values of GGT* (P<0.01) *& GOT.*

Discussion

➢ The LFI index have well discriminated the patterns of all the APP (+ and -) between the 4 groups.

➢ Therefore, **LFI is related to liver function:**

✓ positively with **–APP** (RBP, PON, lipoproteins, …), usual proteins synthesised to satisfy many metabolic function;

✓ negatively with **+APP** (haptoglobin, globulin, …), proteins synthesised to answer to immune system challenge (by cytokines release), and other parameters (i.e. bilirubin, GGT) that increase when usual liver function are impaired.

➢ Interestingly, LFI index appear also well related to performances of each group: clinical problems (negatively), milk yield and fertility (positively).

➢ The reduction of performances with low LFI could be justified:

✓ directly: trough the systemic action of pro-inflammatory cytokines

✓ indirectly: by the worsening of the negative energy balance around calving due to the inflammatory-like conditions. In fact, the LO group showed the lowest levels of glucose & urea and the highest of NEFA & BOHB, suggesting a lower DMI and a higher lipomobilization (as confirmed by the more marked decrease of BCS)

Conclusions

➢These data confirm that:

✓high milk yield in "healthy" cows did not impair the reproductive function

✓clinical and sub-clinical health problems in the transition period, eliciting an inflammatory-like condition, are the responsible of reduced performances;

➢A complex index of liver function as LFI seems a promising tool to diagnose inflammatory conditions around calving, to predict poor performances (milk yield & fertility) and to advance appropriate therapies.