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Association Between A.I. Result and Some Metabolic Parameters in Dairy Cows

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Abstract: Relations between AI outcome and some metabolic parameters (Urea, Ammonia, Glucose, Cholesterol, Triglycerides, NEFA, β-OHT and Progesterone) were assessed in dairy cows. Significant differences were present most of all in the 35-140 days postpartum period. The concentration of haematic Ammonia seem to be a very important factor conditioning AI outcome; both as hepatic functionality index and for toxic effects on neuroendocrine control mechanisms, including reproductive function.

Key words: Cow, artificial insemination, metabolic findings, association, dairy cows

INTRODUCTION

During the last twenty years the average milk yield in dairy cows has dramatically increased, at the same time a significant reduction of fertility has been observed. Data on a considerable increase in the calving interval (Lucy, 2001) and a significant reduction of the Conception Rate (CR) at the first service from 65 to 40% (Butler, 1998) have been published in the last years. The decrease in reproductive efficiency is one of the most relevant factors of economic loss in dairy farms, its incidence on the milk cost is estimated to be around 10% (Royal *et al*., 2000). In early lactation the energy provided by the food intake is not enough to support milk production (Butler and Smith, 1989) the resulting shortfall of energy is thought to be met by mobilizing body reserves and this could affect the resumption of reproductive activity (Lucy, 2001).

Energy and protein metabolism plays a key role for the resumption of estrus cycle and the reproductive success in dairy cows. Negative Energy Balance (NEB) and high levels of ammoniemia are considered crucial for the reduction in fertility typical of this postpartum period. NEB can affect the pulsatile secretion of LH (Butler and Smith, 1989) while high levels of ammonia in blood could impair the delicate reproductive mechanism, changing the composition of the follicular fluid or the uterine environment (Hammon *et al*., 2005) and interfering with oocyte transport (Berardinelli *et al*., 2001). Both NEB and ammonia are involved in neuro-hormonal actions that deeply influence feed-forward mechanisms which are responsible of a strict control on reproductive activity at central level. Through the same pathway the negative action of repeated stressors can be synergic with the effects of nutritional unbalance (Dobson *et al*., 2003).

MATERIALS AND METHODS

This study was conducted in two dairy farms in the northeast of Italy, on a total of 95 lactating Holstein Friesian cows. Blood samples were taken weekly (day and hour of the sampling were constant) from February to August. The animals entered the sampled group when inseminated in the 7 days preceding the day of sampling and leaved the group after a positive ultrasonographic diagnose of pregnancy performed between 25 and 35 days from Artificial Insemination (AI).

AI was performed 12 h after the clinical signs of estrus, by skilled operators using frozen semen from bulls of proven fertility. Pregnancy diagnosis was performed by a veterinarian practitioner using a portable scan (B-mode Dynamic Imaging LTD Livingston-Scotland UK; linear 5 Mhz).

Blood was sampled from the jugular vein and collected in vials with lithium heparin. One drop of whole blood was used immediately to determine ammoniemia (PocketChem BA-Ammonia Test Kit II™, Menarini) then samples were centrifuged at 3000 rpm for 15 min and plasma divided into three share and frozen at -20°C until analysis. The following parameters were examined:

Urea (UREA, ureasis UV kinetic test), glucosium (GLU, hexokinase UV test), Cholesterol (CHOL, colorimetric enzymatic test), Triglyceride (TG, colorimetric enzymatic test), Non-Esterified Fatty Acid (NEFA, spectrophotometric method), βeta-hydroxybutyrate (β-OHB, 3 hydroxybutyrate dehydrogenase UV kinetic test).

Progesterone (P4) was evaluated in the samples obtained between 12 and 18 days postpartum using a RIA method.

Body Condition Score (BCS) and milk yield were recorded the day in which blood samples were taken.

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Table 1: The data reported according to the AI result the days from calving interval

Parameter	AI result	Days from calving (35-140)	Days from calving (141-180)	Days from calving (>181)
BCS	+	2.78±0.02 *	2.75±0.03	2.75±0.03*
	-	2.70±0.02	2.77±0.03	2.90±0.03
Milk yield Kg/cow/day	+	47.3±0.9*	47±2	44±1
	-	45±1	45±1	41±1
UREA mmol L^{-1}	+	2.8±0.2*	3.8±0.3	3.8±0.2*
	-	3.5±0.1	3.3±0.2	2.9±0.2
NH4 µmol L^{-1}	+	80±6*	93±10	99±10
	-	104±5	104±9	107±10
GLU mmol L^{-1}	+	3.54±0.06	3.50±0.09	3.51±0.09
	-	3.50±0.05	3.50±0.08	3.60±0.09
CHOL mmol L^{-1}	+	6.4±0.2*	7.1±0.3*	7.0±0.3*
	-	5.8±0.1	6.3±0.2	5.6±0.3
TG mmol L^{-1}	+	0.116±0.004*	0.132±0.007	0.143±0.007
	-	0.128±0.004	0.136±0.005	0.133±0.007
NEFA meq L^{-1}	+	0.16±0.01*	0.20±0.02	0.21±0.02
	-	0.21±0.01	0.17±0.02	0.17±0.02
β OHB mmol L^{-1}	+	0.45±0.01*	0.34±0.02*	0.35±0.02
	-	0.35±0.01	0.41±0.02	0.39±0.02
P4 ng mL^{-1}	+	6.1±0.5	6.2±0.9	5.4±0.4
	-	5.4±0.4	5.7±0.6	7.5±0.8

Within each class of distance from calving, significant differences ($p<0.05$) between + and-are indicated with (*)

Data were analyzed using a GLM (SIGMASTAT 2.03), considering AI result and days from calving (3 levels: 35-140 days, 141-180 days, >180 days) as independent variables

RESULTS

The data reported in Table 1 refer to 46 animals (for a total of 348 samples) sorted according to the AI result and the days from calving interval.

DISCUSSION

Significant differences are mainly in the group of samples taken 35-140 days after calving, suggesting that the differences found later in the postpartum could involve other factors, like management or environment, not directly connected with NEB.

Average BCS is higher in pregnant cows and this agree with knowledge on NEB effects. Direct assessment of energy balance in individual cows is not possible but changes in BCS provide an indirect measure and the more extensive is the loss, the greater becomes the reduction in conception rate (Garnsworthy and Webb, 1999).

Plasma UREA and NH4 concentrations are lower in pregnant cows, also this finding agrees with data recently published by other Authors (Hammon *et al*., 2005; Rhoads *et al*., 2006) supporting the idea that high plasma urea nitrogen concentrations, perturbing the uterine milieu and altering the follicular fluid, could impair the delicate reproductive mechanism and be associated with decreased fertility in lactating dairy cows.

The not significant difference found in the levels of GLU between pregnant and open cows could seem in contrast with current knowledge (Butler, 2003) but it is difficult to draw conclusion from this finding without knowing the correspondent levels of insulin in this animals.

The fact that levels of CHOL are higher in pregnant cows seem to be more easily to understand considering the influence of the energy balance than the role of CHOL as precursor of steroid hormones. Also if plasma CHOL is known to be significantly correlated with other variables like P4, conception rate and number of recoverable embryos this association merits further investigation (Francisco, 2003). The non significant difference in P4 levels could be due to the limit of having considered only the samples of a short period (12-18 dd postpartum).

The significantly higher TG and NEFA levels in open cows are in relation with energy balance and with increased lipolysis in adipose tissues, lipid synthesis and accumulation in the liver. The opposite trend of β OHB is not necessarily strange, because it has been shown that ketone bodies inhibit protein degradation and thereby gluconeogenesis and also are able to spare glucose by inhibiting glucose utilization (Holtenius, 1996).

The frequently reported correlation between high production and reproductive problems was not found, suggesting that the top producer cows may be the group of animals that cope with and adapt best to the challenges arising in an intensive dairy farm.

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