Effects of automatic milking system on some plasma parameters related to oxidative status in primiparous dairy cows

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INTRODUCTION – The introduction of the automatic milking system (AMS) offers an opportunity to avoid the hard routine of traditional milking parlour (MP), but requires an evaluation on cow health and physiology, particularly during early lactation. Metabolism and environmental agents can cause oxidative stress, as result of an imbalance between endogenous production of reactive oxygen metabolites (ROMs) and neutralizing capacity of antioxidant mechanisms. Therefore, the oxidative status of the cow may affect several important functions such as milk yield, reproduction and immunity (Gabai et al., 2004; Stefanon et al., 2004). Bernabucci et al. (2003) reported periparturient levels of plasma thiol groups (SHp) to describe antioxidant potential in heat stressed dairy cows. The antioxidant role of albumin, mainly due to its free thiol groups, was previously highlighted from Nicholson et al. (2000). The aim of this study was to compare the oxidative status of primiparous dairy cows in a traditional MP with that of primiparous dairy cows in an AMS, during the first stage of lactation, to evaluate cow’s welfare in relation to the milking system (MS).

MATERIAL AND METHODS – Twenty Italian Friesian heifers were chosen within two comparable dairy herds into the same free-stall barn, one herd being milked in MP and one herd being milked with an AMS (VMS™, DeLaval, Tumba, Sweden). Both groups were fed with the same total mixed ration. Blood samples were obtained before morning feeding, from jugular vein, at -14, 7, 14, 28, 42, 70, 98, and 154 days in milk (DIM). Plasma was separated by centrifugation (2850 x g for 20 min), and frozen at -20°C. Plasma was tested...
for total protein, globulin, albumin, and ceruloplasmin concentration accordingly to Bertoni et al. (1998). Determination of SHp and ROMs was run with colorimetric methods (Diacron, Grosseto, Italy). Statistical analysis was conducted with an ANOVA using the MIXED procedure of SAS (SAS Inst., Inc., Cary, NC), considering MS, DIM, and their interaction as main factors, with the -14 d control as a covariate.

RESULTS AND CONCLUSIONS

Both groups had ROMs values that can be considered markers of a low oxidative stress when compared with those reported from Bernabucci et al. (2003) and more similar to those reported from Formigoni et al. (1997). There was no significant difference in plasma ROMs between MS (P>0.05), even if AMS group had lower ROMs levels from 28 to 98 DIM (Figure 1). We observed a significant effect of DIM (P=0.005), with a progressive reduction of ROMs in the first month of lactation; this pattern agrees with that reported by Formigoni et al. (1997). There was no interaction between milking system and DIM (P>0.05). Data analysis pointed out a positive correlation (r=0.498, P<0.001) between ROMs and ceruloplasmin plasma levels. This finding agrees with that of Stefanon et al. (2004) on ceruloplasmin pattern in primiparous cows during the periparturient period, when it increases jointly with some markers of oxidative stress.

The main explanation of this positive correlation could be the role of ceruloplasmin as endogenous modulator of the inflammatory response and as scavenger of oxygen-derived free radicals (Cousins, 1985). No differences were found (P>0.05) in SHp level between MP and AMS, and SHp values after calving were quite similar, even if slightly lower, to those obtained by Bernabucci et al. (2003). There was a significant effect of DIM on SHp (P<0.001), with a significant increase from the first 14 DIM to 154 DIM. Cows in MP had higher SHp values than those observed in AMS at 7 DIM (P=0.06), and from 70 DIM to the end of the trial (NS), as showed in Figure 1. These results confirmed the trend of plasma antioxidant potential to recover in the first half of lactation (Gabai et al., 2004). The SHp:albumin ratio was evaluated to understand the role of albumin in this recover. Plasma albumin increased from calving to 154 DIM (P<0.001) as a result of reestablished normal liver function. Cows in AMS had higher level of plasma albumin during the first month of lactation (33.49 vs. 35.15 g/L for MP and AMS respectively; P<0.05); then, the mean level stabilized. Plasma albumin of MP cows increased almost linearly from parturition, reaching the same values of AMS at 70 DIM. The SHp:albumin ratio was not affected by MS (P>0.05; Figure 2), confirming the results of both ROMs and SHp that demonstrate...
strated a similar oxidative status between the systems. The significant increase of SHp:albumin ratio (P<0.001) during the first half of lactation suggests that the albumin variation did not completely explain the SHp rise observed in this period. There was no interaction between MS and DIM on SHp:albumin ratio (P>0.05), even if MP cows showed higher levels at 7 DIM (P=0.05).

Figure 2. Values of the SHp:albumin ratio in plasma of cows milked in the milking parlour (■) and in the automatic milking system (◆) during the first 154 d of lactation (* P = 0.05).

Our results suggest no relevant influences of MS on oxidative stress and antioxidant potential. Plasma albumin plays an important role in providing SHp groups contributing to antioxidant pool, but the rise in thiol groups from 7 to 154 DIM seems to be due not only to the increase in plasma albumin in the same period.

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