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The Effects of Dry Period Versus Continuous Lactation on Metabolic Status and Performance in Periparturient Cows

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ABSTRACT

It has been argued that dairy cows with a high genetic milk production potential can maintain high milk production even with total omission of the dry period. Further, when omitting the dry period, cows are believed to experience fewer metabolic changes during the transition from late gestation to early lactation compared with cows having a traditional dry period. The performance and metabolic response to omission of the dry period for cows with an expected peak milk yield higher than 45 kg/d were studied in 28 Holstein dairy cows. The cows were followed in late gestation and in the subsequent 5 wk of early lactation. Fourteen cows were milked through late gestation (CM) and another 14 dairy cows underwent a 7-wk dry period (DRY). In the early lactation period, the cows had the same dry matter (DM) intake but cows in the CM group had a 22% reduction in milk yield compared with the cows in the DRY group. At calving, the experimental groups had the same average body weight and body condition score and there were no significant differences in body weight and body condition score changes in early lactation. However, the cows in the CM group compared with the cows in the DRY group had a higher plasma concentration of glucose and insulin and a lower plasma concentration of nonesterified fatty acids and β-hydroxybutyrate in the following 5 wk of early lactation. Furthermore, the cows in the CM group had lower liver triacylglycerol concentration and higher liver glycogen concentration in the following early lactation. It is concluded that, even in dairy cows with an expected peak milk yield above 45 kg/d, omission of the dry period results in a relatively high reduction in milk yield in the following early lactation. Furthermore, these cows are in less metabolic imbalance in the following early lactation.

(**Key words:** continuous lactation, metabolic status, performance, liver)

Abbreviation key: CM = cows with omission of the dry period, **DRY** = cows having a 7-wk dry period, **ECM** = energy-corrected milk, **PUN** = plasma urea nitrogen, **TAG** = triacylglycerol.

INTRODUCTION

The high-yielding dairy cow experiences massive metabolic changes during the transition from the dry period in late gestation to the onset of copious milk secretion in early lactation (Bell, 1995; Ingvartsen and Andersen, 2000). During this period the cow has to adapt to a dramatic and several-fold increase in nutrient uptake by the mammary gland associated with lactogenesis compared with the much smaller nutrient requirement in late gestation by the growing conceptus. The periparturient period is thus associated with an increased incidence of metabolic and production-related diseases, including fatty liver and ketosis, arising because of inadequate homeorhetic adaptation of metabolism (Ingvartsen and Andersen, 2000; Ingvartsen et al., 2003; Friggens et al., 2004).

The 6- to 8-wk dry period is included in the traditional dairy management between successive lactations to ensure optimal milk production in the following lactation (Swanson, 1965; Sørensen and Enevoldsen, 1991; Remond et al., 1997a,b). Indeed, several studies have demonstrated that total omission of the dry period (i.e., continuous lactation) decreases milk production in the following lactation by 20 to 40% (Sanders, 1928; Swanson, 1965; Smith et al., 1967; Remond et al., 1997a,b). However, the level of milk production in these studies has been relatively low—between 20 and 30 kg/d at peak lactation. In a French study from the mid-1990s, it was reported that continuous lactation had been practiced successfully for 15 yr in a commercial dairy herd with a production level >10,000 kg of energy-corrected milk (**ECM**) (Remond and Bonnefoy, 1997). A recent study by Annen et al. (2004a) further demonstrated that continuous lactation had no negative influence on

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milk production in the subsequent lactation in bST-treated multiparous dairy cows with a production level >12,000 kg of ECM, whereas primiparous cows had lower production postpartum. These results could be explained by the bST treatment because somatotropin and IGF-I in the bovine seem to be some of the most important hormones controlling the processes involved in mammary redevelopment in the dry period including cell death (apoptosis) and proliferation (Accorsi et al., 2002). Genetic selection for milk yield has resulted in dairy cows with an inherent, higher endogenous somatotropin secretion (Kazmer et al., 1986). It is therefore tempting to hypothesize that, even in cows not treated with bST, it may be possible to maintain very high milk production under continuous lactation management, provided the cows are of a high genetic merit and kept in a herd with a high standard of management.

Another interesting observation in the French study was that, when omitting the dry period, the cows had an atypically low mobilization of BW in the following early lactation, suggesting lesser negative energy balance in early lactation (Remond and Bonnefoy, 1997). An explanation of this could be that the continuously lactating cow experiences less dramatic metabolic changes during the transition from late gestation to early lactation due to: 1) achievement of higher peak feed intakes in the following early lactation and at a faster rate as a result of a more functional rumen; or 2) depression of milk production in the following lactation due to impaired mammary redevelopment prepartum.

The objective of this study was to evaluate if omission of the dry period for high-yielding, nonbST-treated dairy cows can 1) be practiced without significant negative influence on milk yield in the following lactation; and 2) reduce the metabolic imbalance associated with the onset of lactation.

Changes in a variety of blood metabolites, hormones, liver triacylglycerol (**TAG**), and glycogen contents were followed as indicators of metabolic status and adaptive changes in the periparturient period (Andersen et al., 2002, 2004).

MATERIALS AND METHODS

Experimental Animals and Design

A homogeneous group of 28 Danish Holstein dairy cows (11 in first lactation; 17 in ≥second lactation) were selected from among the cows with the highest merit for milk yield and a good health record (i.e., treatment frequency and days open in previous lactation) in the dairy herd of the Danish Institute of Agricultural Sciences, Research Center Foulum (Tjele, Denmark).

Seven weeks before expected calving date, the cows were blocked according to genetic merit of milk yield, lactation number, and BW after calving in the first lactation and randomly allocated to 1 of 2 experimental groups. The cows in the control group (**DRY**, 5 in first lactation; 9 in ≥second lactation) were dried off 7 wk before expected calving. The cows in the continuous lactation group (**CM**, 6 in first lactation; 8 in ≥second lactation) were milked until parturition unless the daily milk yield declined to less than 5 kg/d.

All cows were fed the same TMR twice a day at 0800 and 1400 h and had free access to water. The TMR was a mixture of corn silage (33.3%), grass silage (20.9%), rolled barley (10.1%), grass pellets, dried (13%), rapeseed cake (17.6%), sugar beet molasses (4.6%), and feed urea (0.5%). From 7 to 3 wk before expected calving, the cows in group DRY were fed restrictedly (9 kg of DM of the TMR) and barley straw ad libitum, according to Danish norms for dry cows (Strudsholm et al., 1999). Until calving and in the following lactation, these cows were fed TMR ad libitum. The cows in the CM group were fed TMR ad libitum throughout the experiment. Further, all cows received a daily supplement of mineral, salt, and vitamin mixture to fulfill the requirements of the Danish norms (Strudsholm et al., 1999). A daily feed refusal of 5% or more was the aim for TMR fed ad libitum. All daily milkings were performed at 0430 and 1530 h. The cows were kept in a tie-stall barn and bedded with barley straw twice daily. The experimental period was from 7 wk before expected calving to 6 wk after the actual calving date.

The experimental procedures were conducted under the protocols approved by the Danish Animal Experiments Inspectorate and complied with the Danish Ministry of Justice Law no. 382 (June 10, 1987) and Acts 739 (December 6, 1988) and 333 (May 19, 1990) concerning animal experimentation and care of experimental animals.

Two cows from the DRY group were excluded due to amputation of teats in connection with mastitis just after calving. Another 2 cows in the CM group dried themselves off in connection with mastitis approximately 2 wk prepartum. These cows were excluded from the experiment. In total, 7 of the cows in the CM group were dried off between 7 and 2 d prepartum due to a milk yield of less than 5 kg/d, given an average dry period length for these cows of 4 ± 4 d. The average dry period length of the cows in the DRY group was 47 ± 5 d.

Registration and Sampling

Feed intake was recorded daily and feed was sampled as described by Ingvartsen et al. (2001). All cows were weighed 7 wk prepartum (time of drying-off for DRY cows) and subsequently every week on a fixed day and