J. Dairy Sci. 101:1–16
https://doi.org/10.3168/jds.2017-13448

Udder health of dairy cows fed different dietary energy levels after a short or no dry period without use of dry cow antibiotics

R. J. van Hoeij,*[1] T. J. G. M. Lam,†‡ R. M. Bruckmaier,§ J. Dijkstra,# G. J. Remmelink,‖ B. Kemp,* and A. T. M. van Knegsel*

*Adaptation Physiology Group, Department of Animal Sciences, Wageningen University and Research, 6700 AH, Wageningen, the Netherlands
†Department of Farm Animal Health, Utrecht University, 3508 TD, Utrecht, the Netherlands
‡GD Animal Health, 7400 AA, Deventer, the Netherlands
§Veterinary Physiology, Vetsuisse Faculty, University of Bern, CH-3001 Bern, Switzerland
#Animal Nutrition Group, Department of Animal Sciences, and
‖Livestock Research, Wageningen University and Research, 6700 AH, Wageningen, the Netherlands

ABSTRACT

Reports on the effects of length of dry period (DP) on udder health of cows that were not treated with dry cow antibiotics are scarce. Additionally, the effects of a reduced dietary energy level for cows with a 0-d DP on udder health have not yet been studied. The aims of this study were (1) to compare effects of a 0-d or 30-d DP without use of dry cow antibiotics on udder health across the DP and subsequent lactation in dairy cows fed different dietary energy levels and (2) to evaluate associations between udder health and metabolic status of dairy cows. Five weeks before the expected calving date, Holstein-Friesian dairy cows (n = 115) were blocked for parity, expected calving date, and milk yield and SCC at their 2 last test days and were randomly assigned to 2 DP lengths: 0-d DP (n = 77) or 30-d DP (n = 38). Quarter milk samples were taken in wk 5 prepartum and in wk 1 and 5 postpartum. Proportion of quarters with elevated somatic cell count (SCC; SCC ≥200,000 cells/mL) and proportion of udder pathogens in quarter milk samples did not differ between DP lengths among weeks. After calving, 102 of these cows were randomly assigned to 3 treatments: a 30-d DP with a standard energy level required for expected milk yield (30-d DP SEL; n = 36), a 0-d DP with the same energy level as cows with a 30-d DP (0-d DP SEL; n = 33), and a 0-d DP with a low energy level (0-d DP LEL, n = 33). From wk 8 of lactation onward, cows received either a glucogenic ration consisting of corn silage and grass silage or a lipogenic ration consisting of grass silage and sugar beet pulp at a standard or low energy level. During wk 1 to 7 postpartum, treatment did not affect SCC or SCC corrected for milk yield. During wk 8 to 44 of lactation, 0-d DP SEL cows had a greater SCC than 0-d DP LEL or 30-d DP SEL cows and had a greater SCC corrected for milk yield than 0-d DP LEL cows. During wk 1 to 44 of lactation, occurrence of at least 1 elevation of SCC (SCC ≥200,000 cells/mL after 2 wk of SCC <200,000 cells/mL) was not different among treatments. The 0-d DP SEL cows but not the 0-d DP LEL cows tended to have a 2.17 times greater hazard of having a case of clinical mastitis at any time in lactation than 30-d DP SEL cows. In wk 1 to 44 of lactation, lower fat- and protein- corrected milk yield and energy intake, greater energy balance, and greater plasma insulin concentration were associated with greater SCC. In conclusion, DP length did not affect udder health in the DP and in early lactation but seemed to decrease udder health for 0-d DP SEL cows in later lactation compared with 30-d DP SEL or 0-d DP LEL cows.

Key words: continuous milking, decision making, antibiotic use

INTRODUCTION

The dry period (**DP**) is an important period in the dynamics of IMI in dairy cows (Green et al., 2005; Pantoja et al., 2009b; Scherpenzeel et al., 2014). Management of the DP with respect to udder health aims to both cure existing IMI and reduce the risk of new IMI during the DP (Collier et al., 2012). Management measures to reduce the risk of new IMI during the DP include herd-level measures such as housing, hygiene, and nutrition and cow-level measures such as use of dry cow antibiotics or internal teat sealants (Annen et al., 2004; Green et al., 2007). Use of dry cow antibiotics improves the cure rate of existing IMI during a DP (Williamson et al., 1995). However, use of antibiotics may increase bacterial resistance, which raises a hazard for treatment of human and animal bacterial infection

Received July 6, 2017.
Accepted December 15, 2017.
[1]Corresponding author: ariette.vanknegsel@wur.nl

(van den Bogaard and Stobberingh, 2000; Tenhagen et al., 2006). Preventive use of antibiotics (e.g., dry cow antibiotics in cows without an IMI) is therefore not allowed in several European countries, including the Netherlands, and use of dry cow antibiotics is restricted for treatment of diagnosed IMI based on SCC or bacterial culture (Dutch Ministry of Economic Affairs, 2017).

Shortening or omitting the DP has been hypothesized to affect udder health in dairy cows, although reported effects are ambiguous. Compared with a conventional DP length (49–60 d), a short (28–35 d) or omitted (0 d) DP decreased SCC in the subsequent lactation (Gulay et al., 2003; Pinedo et al., 2011), resulted in no difference in SCC (Rastani et al., 2005; Watters et al., 2008; Bernier-Dodier et al., 2010), or increased SCC (Kuhn et al., 2006; Pezeshki et al., 2007; Steeneveld et al., 2013). A conventional DP length, compared with a short DP, tended to reduce the number of IMI in the subsequent lactation in some studies (Pezeshki et al., 2007; Pinedo et al., 2011), whereas other studies found no effect of shortening (Church et al., 2008; Shoshani et al., 2014; van Hoeij et al., 2016) or omitting (van Hoeij et al., 2016) the DP on clinical mastitis in the subsequent lactation. To our knowledge, all studies on the effect of DP length on udder health have been carried out using cows that were treated with dry cow antibiotics at drying off. Given the changed antibiotic policy in many countries and to study effects of DP length without the confounding effect of dry cow antibiotics, cows were not treated with dry cow antibiotics in the current study.

Metabolic status may negatively affect udder health (Ingvartsen and Moyes, 2013; Mayasari et al., 2016). Increased lipid accumulation in the liver and elevated plasma nonesterified fatty acid concentrations are associated with a greater risk for ketosis (Drackley, 1999). For example, Suthar et al. (2013) reported that cows with subclinical ketosis during the first 2 wk postpartum had a 9.5 times greater odds of developing clinical mastitis during that period than cows without subclinical ketosis. Moreover, Kremer et al. (1993) reported in wk 3 to 6 of lactation that cows that had ketosis postpartum—that is, cows that had elevated concentrations of BHB and free fatty acids (**FFA**) along with a low plasma glucose concentration—had more severe mastitis, indicated by greater bacterial growth in the quarter inoculated with *Escherichia coli*, than nonketotic cows. To our knowledge, no studies on direct associations between calculated energy balance (**EB**) or associated plasma metabolites and udder health in a complete lactation have been undertaken. We hypothesized that cows with a less negative EB would have lower plasma FFA and BHB concentrations and have better udder health than cows with a greater negative EB.

Shortening or omitting the DP improved the metabolic status of dairy cows in early lactation through a reduction in postpartum milk yield compared with a conventional DP of 8 wk (Rastani et al., 2005; van Knegsel et al., 2014). To date, effects of DP length on milk yield and EB in the subsequent lactation have always been evaluated with a lactation ration containing the same energy level for all cows. It is possible that, for cows with no DP, because of their lower postpartum milk yield, feeding a ration lower in dietary energy level throughout lactation or feeding a less glucogenic ration after peak milk yield might reduce the risk of developing excess fat reserves, which is beneficial for herd health and productivity. Recently, we reported that reducing the dietary energy level for cows with 0-d DP reduced the positive EB in wk 6 and 7 of lactation but did not affect milk yield in early lactation compared with cows that received a standard energy level (van Hoeij et al., 2017a). Further research on the effects of DP length and feeding different dietary energy levels on udder health during mid and late lactation is needed.

The first aim of this study was to compare the effect of a 0-d or 30-d DP without use of dry cow antibiotics on udder health across the DP and the subsequent lactation (up to 44 wk of lactation). The second aim was to evaluate effects of dietary energy level in wk 4 to 44 of lactation on the udder health of cows with different DP lengths. The third aim was to evaluate associations between metabolic status and udder health of dairy cows.

MATERIALS AND METHODS

Animals and Housing

The Institutional Animal Care and Use Committee of Wageningen University and Research (Wageningen, the Netherlands) approved the experimental protocol in compliance with Dutch law on animal experimentation (protocol no. 2014125). The experimental design, DP lengths, and dietary contrasts were described previously (van Hoeij et al., 2017b). For this experiment, cows were selected based on (1) being bred with a Holstein sire, (2) expected calving interval <490 d, (3) daily milk yield >16 kg at 90 d before the expected calving date, and (4) no clinical mastitis and an SCC <250,000 cells/mL at the last 2 test days before randomization. Cows were permanently housed in a freestall barn with a slatted floor and cubicles. Dry cows were housed separately from lactating cows. Cows were milked twice daily at approximately 0600 and 1800 h. The experimental period of the current study started in wk 5 prepartum and lasted until wk 44 of lactation.