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## A single prolonged milking interval of 24 h compromises the well-being and health of dairy Holstein cows

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### ABSTRACT

Cows are often shown at dairy shows with overfilled udders to get a better show placing. However, it is unclear to what degree “over-bagging” affects the health and well-being of show cows. The goal of this study was to assess the effect of a single prolonged milking interval (PMI) of 24 h on the measurable signs of health and well-being in dairy cows in early and mid-lactation and to assess the effect of a nonsteroidal anti-inflammatory drug (NSAID) on well-being during a PMI. Fifteen Holstein cows were studied in early lactation ( $89.5 \pm 2.7$  d in milk) and were given an NSAID or physiological saline in a crossover design. Ten cows were studied again in mid-lactation ( $151.6 \pm 4.0$  d in milk). Data on clinical signs of cows’ health, behavior, and well-being were collected at 1 or 2 h intervals before and during a PMI of 24 h. Data from the last 6 h of a 12 h milking interval were compared with the last 6 h of the PMI. Compared with that of a cow in the last 6 h of a 12-h milking interval, the behavior of cows in early lactation (saline group) changed during the last 6 h of the PMI: we observed decreased eating time (22.4 vs. 16.2 min/h), increased ruminating time (13.3 vs. 25.0 min/h), and increased hind limb abduction while walking (score 41.7 vs. 62.6) and standing (31.2 vs. 38.9 cm). Udder firmness was increased (2.9 vs. 4.5 kg) during this period and more weight was placed on the hind limbs (46.4 vs. 47.0%). We also found pathological signs at the end of the PMI: all cows showed milk leaking, and 10 of 15 cows developed edema in the subcutaneous udder tissue. Somatic cell count was significantly increased from 12 h to 72 h after the PMI. Administration of an NSAID had no influence on measured variables, except that the occurrence of edema was not significantly increased during PMI in the flunixin group (10 of 15 and 6 of 15 cows for the saline and flunixin groups, respec-

tively). In the cows in mid-lactation, different variables were not significantly changed in the PMI compared with baseline values (e.g., eating and ruminating time, occurrence of edema, and abduction). We conclude that the cows’ health and well-being were compromised by a single PMI of 24 h, because their behavior changed and pathological signs were recorded. Administration of an NSAID had a slight effect on cows’ well-being during a PMI. The stage of lactation had more effect on the cows’ health and well-being, because fewer variables were changed in mid-lactation.

**Key words:** prolonged milking interval, animal well-being, over-bagging, dairy cow show

### INTRODUCTION

Cows at national and international dairy cow shows are often presented with extremely filled udders in order to attain a better show placing. This “over-bagging” of the udder might be painful, and therefore an animal welfare issue (Gleeson et al., 2007; Kohler and Steiner, 2013). Freedom from discomfort and from pain are 2 of the 5 freedoms stated in the Terrestrial Animal Health Code of the World Organisation for Animal Health (OIE, 2015). Over-bagging and the unnecessary suffering of show cattle is against the showing regulations of many show organizations around the world, including Switzerland (ASR, 2011), the United Kingdom (HUK, 2011), and the United States (WDE, 2015). However, guidelines are formulated vaguely and lack objective control methods to assess animal welfare and over-bagging. Over-bagging is said to be one of the most severe problems still to be solved in show ethics (Geiger, 2015). Currently, over-bagging is either not enforced as a violation of dairy shows’ code of ethics, or it is enforced by subjective assessment of cows’ behavior from a show veterinarian. In a preliminary study (Kohler and Steiner, 2013), assessment of well-being by veterinarians and show judges, using visual analog scales to describe well-being and udder fill, proved to be very subjective and not a feasible tool for monitoring animals’ well-being. It is presumed that nonsteroidal anti-

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inflammatory drugs (**NSAID**) are used to cover the signs of impaired well-being in over-bagged show cows, and this practice complicates the subjective detection of over-bagged cows. Nonsteroidal anti-inflammatory drugs are usually administered at the last milking before the cow show, because it is not allowed to use these substances for this indication at the show site (personal communication, A. Wyss, Federal Food Safety and Veterinary Office, Berne, Switzerland).

A single prolonged milking interval (**PMI**) of 24 h may cause an increase in SCC by inducing an inflammatory reaction and increasing the permeability of the udder (Lakic et al., 2009, 2011). The blood-milk barrier switches to a leaky state at approximately 18 h after the last milking (Stelwagen et al., 1997). Additionally, a PMI can lead to edema in the subcutaneous udder tissue (Waller et al., 2007). Cows show higher locomotion scores and more cows show milk leakage in once-a-day milking systems compared with twice-a-day milking systems; furthermore, udder firmness is increased in these cows (Tucker et al., 2007). Gait score and weight distribution are also affected by milking (Chapinal et al., 2009). Gait score is increased and more weight is placed on the hind limbs 1 h before milking, compared with immediately after milking. As well, abrupt drying off causes increased extramammary pressure, and—in high-yielding cows—even increased fecal glucocorticoid concentration (Bertulat et al., 2013), indicating that over-bagging is stressful.

The objectives of the current study were to investigate the effect of a sudden change to a PMI of 24 h in early and mid-lactation, and to investigate the effect of NSAID administered before the PMI on several variables of animal health and well-being. We hypothesized that during the last 6 h of the PMI, behavior would be different, and that udder firmness, udder surface temperature, edema in the subcutaneous udder tissue and milk leakage would be increased compared with the control period. Additionally, we expected an increase in SCC after a single PMI of 24 h.

## MATERIALS AND METHODS

### *Animals, Housing, and Milking*

The study was conducted at an agricultural research station (Agroscope Liebefeld-Posieux, Posieux, Switzerland) from May to December 2014. The 15 cows (10 Holstein Friesian and 5 Red Holstein) studied in early lactation averaged  $89.5 \pm 2.7$  DIM (mean  $\pm$  SD), and parity was  $2.8 \pm 1.0$  (age  $4.7 \pm 1.2$  yr). The cows yielded  $31.0 \pm 7.0$  kg [interquartile range (**IQR**) 25.3–34.9 kg] milk/d (305-d milk yield  $7,364 \pm 1,040$  kg; IQR

6,440–8,130 kg) and had a BW of  $681.5 \pm 68.8$  kg (IQR 628.5–712.0 kg). The 10 cows studied in mid-lactation averaged  $151.6 \pm 4.0$  DIM, and parity was  $2.6 \pm 0.9$  (age  $4.6 \pm 1.3$  yr). They yielded  $28.4 \pm 4.3$  kg (IQR 26.0–32.1 kg) milk/d (305 d milk yield  $7,310 \pm 1,057$  kg; IQR 6,512–7,829 kg) and had a BW of  $684.4 \pm 79.6$  kg (IQR 612.8–713.0 kg). During the experiments, cows were individually housed in a tie-stall barn and had free access to water, offered in individual drinking bowls. Cows were fed hay and corn silage (summer feeding) or TMR (winter feeding) and received additional concentrate and mineral feed according to their current milk yield. The experimental protocol was approved by the Ethics Committee for Animal Experimentation of the Canton of Fribourg, Switzerland (#2014\_08\_FR).

During the study, cows were always milked by the first author (PK) using a bucket milking system (SAC, Kolding, Denmark) at 0500 and 1700 h. The milking cluster was attached after a pre-stimulation time of 2.5 min. During pre-stimulation, the udder was cleaned, the California Mastitis Test was performed, and separate aseptic milk samples were taken from each quarter. Post-milking stimulation started when milk flow decreased to  $<0.2$  kg/min. After a short manual stimulation, the cluster was detached and the teats were dipped with Mammo-Derm (Multisfora, Auw, Switzerland).

### *Experimental Design*

The study consisted of 3 experiments. Experiment 1 and 2 were performed in early lactation (90 DIM;  $n = 15$  cows) and experiment 3 in mid-lactation (150 DIM;  $n = 10$  cows), as shown in Figure 1. After an adaptation period of 3 d with milking intervals of 12 h and habituation to the experimental procedure (cows underwent examinations 3 times per day), experiments generally consisted of 3 periods: a baseline period (**BLP**) of 24 h with milking intervals of 12 h; a PMI of 24 h; and a recovery period (**RP**) of 12 h. In the crossover design of experiments 1 and 2, cows were administered either flunixin meglumine (Flunixinim; Dr. E. Graeb AG, Berne, Switzerland; 2.2 mg/kg BW, i.v.) or an equivalent volume of sterile physiological saline solution i.v. at the beginning of the PMI. The interval between the end of experiment 1 and the beginning of experiment 2 was 7 d. The BLP was not repeated in experiment 2, and for statistical analyses, data from the BLP of experiment 1 were used for experiment 2. For experiment 3, 10 of the 15 study cows were randomly selected. The experimental design was similar to experiment 1, except that all cows were administered sterile physiological saline solution. Data collection during the various periods was performed according to Figure 1.

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