



J. Dairy Sci. 100:1–8
<https://doi.org/10.3168/jds.2017-12760>

© 2017, THE AUTHORS. Published by FASS and Elsevier Inc. on behalf of the American Dairy Science Association®.
 This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/3.0/>).

Locomotion characteristics of dairy cows walking on pasture and the effect of artificial flooring systems on locomotion comfort

M. Alsaod,*¹ S. Huber,* G. Beer,* P. Kohler,* G. Schüpbach-Regula,† and A. Steiner*

*Clinic for Ruminants, Vetsuisse-Faculty, and

†Veterinary Public Health Institute, Vetsuisse-Faculty, University of Bern, 3001 Bern, Switzerland

ABSTRACT

The locomotion comfort of dairy cows depends on the floor of the walking alleys. Optimal locomotion comfort is given when cows walk on pasture, allowing freedom from discomfort and pain and the expression of normal behavior. This study examined the characteristics of locomotion behavior on pasture (gold standard with optimal locomotion comfort) and compared it with behaviors of cows walking on mastic asphalt or solid rubber mats before and after a routine claw trimming session. Our hypotheses were (1) that gait variables were different on pasture versus mastic asphalt and on mastic asphalt versus rubber, and (2) that claw trimming had an effect on gait variables of cows walking on mastic asphalt. Twenty-four dairy cows kept in a tiestall facility were enrolled in this experimental trial. The pedogram was measured using 2 standalone 3-dimensional accelerometers (400 Hz), attached to the metatarsus of both hind limbs. The extracted pedogram variables included temporal events (kinematic outcome = gait cycle and stance-phase and swing-phase durations) and peaks (kinetic outcome = foot load, toe-off). The cows were further video-recorded to calculate walking speed and stride length. Locomotion score was performed on mastic asphalt to enroll only nonlame cows (locomotion score <3). For comparison between different floor types, repeated-measures ANOVA was performed with the cow as a subject variable, session time of measurement as within-subject variable, and flooring type as a fixed effect. Three separate analyses were performed: pasture versus mastic asphalt (analysis I), solid rubber versus mastic asphalt (analysis II), and the effect of claw trimming on the kinematic and kinetic variables on mastic asphalt (analysis III). All tested gait variables were significantly different between pasture and mastic asphalt floor. The optimal characteristics of locomotion comfort on pasture included shorter dura-

tion of gait cycle, longer stance-phase duration, shorter swing-phase duration, higher walking speed, longer stride length, and higher peaks of foot load and toe-off. However, gait variables of cows walking on rubber mats did not show any significant difference compared with the mastic asphalt floor; only stride length tended to be longer on rubber mats. In addition, the stance- and swing-phase durations significantly improved shortly after trimming. The left–right differences of the stance- and swing-phase durations tended to decrease after claw trimming when cows walked on asphalt floor. The results of this study show that solid rubber flooring does not result in significant improvement of the evaluated variables of locomotion comfort compared with mastic asphalt.

Key words: dairy cow, gait cycle, floor, accelerometer

INTRODUCTION

Lameness and foot pathologies in dairy cattle constitute a major welfare concern. Lameness prevalence ranges from 14.8% in Switzerland (Becker et al., 2014) to 54.8% in the northeastern United States (von Keyserlingk et al., 2012). Lameness in cattle is an expression of pain that negatively affects animal welfare and causes considerable economic losses for the dairy producers (Whay et al., 2003; Bruijnijis et al., 2010).

Most research on cow comfort and lameness control in loose housing systems has focused on flooring surface design, because of the direct contact of the feet with the floor (Nordlund and Cook, 2003; Chapinal et al., 2011; Charlton et al., 2016). Poor flooring can affect animal welfare by impairing normal locomotion and thus increasing the risk of lameness and foot disorders (Telezhenko and Bergsten, 2005; van der Tol et al., 2005; Rushen and de Passillé, 2006). Telezhenko (2007) defined the term “locomotion comfort” as the condition of well-being and contentment in the walking areas. According to his definition, optimal locomotion comfort implies “natural gait and activity” and “good condition of the locomotor apparatus” of the animals in the long term (Telezhenko, 2007). Pasture is the

Received February 20, 2017.

Accepted June 3, 2017.

¹Corresponding author: maher.alsaod@vetsuisse.unibe.ch

most comfortable floor for the claws as it provides the optimal balance of the claw horn wear and growth and a natural claw load (Tranter and Morris, 1992). Access to pasture is reported to be beneficial in reducing lameness and the risk of cows being affected by claw disorders compared with zero-grazing herds (Somers et al., 2003; Regula et al., 2004; Hernandez-Mendo et al., 2007). Because of the increasing use of zero-grazing systems and automated milking systems, the access to pasture of cows in many European countries is declining sharply (Ipema, 2015).

In the literature, results describing the effect of floor characteristics on claw health are inconsistent. Haufe et al. (2009) reported a slight effect of floor type (solid rubber, mastic asphalt, and slatted concrete floor) on claw health, whereas Vanegas et al. (2006) reported that foot lesions did not differ between floor types, although locomotion score was higher for concrete-exposed cows than for those on rubber. In contrast, Kremer et al. (2007) and Fjeldaas et al. (2011) reported a higher incidence of sole ulcers for rubber-exposed cows compared with those on concrete.

Concrete and mastic asphalt are hard floors and have been associated with an increased incidence of lameness and foot disorders (Vokey et al., 2001; Cook et al., 2004), due to greater load and pressure on the claw structures (van der Tol et al., 2002) causing slipping and “stiff” gait (Phillips and Morris, 2000). Soft walking surfaces such as solid rubber flooring have become increasingly popular alternatives to hard floors in the walking area of dairy facilities. A soft floor may reduce the pressure on the foot (Nuss et al., 2015) and potentially improve cow comfort (Platz et al., 2008), and may thus reduce the incidence of lameness (Vanegas et al., 2006). However, it has also been shown that cows on rubber flooring have decreased horn wear compared with cows kept on concrete (Vanegas et al., 2006). Functional claw trimming in dairy cows is performed as a routine management procedure to prevent the development of claw disorders (Manske et al., 2002).

The objective measurement of cow gait on different flooring surfaces may allow the differentiation between floors with minimal comfort and those with good locomotion comfort. The characteristics of impaired locomotion due to lameness in dairy cattle include stride shortening, stiff gait (Flower and Weary, 2006), reduced walking speed (Chapinal et al., 2011; Beer et al., 2016), and decreased foot load and time of weight-bearing (Rajkondawar et al., 2006; Van Nuffel et al., 2013; Alsaad et al., 2017b). Three-dimensional (3D) accelerometers attached to both hind limbs can detect (1) alterations associated with lameness and foot pathologies of the hind limbs (Alsaad et al., 2017b), and (2) changes in gait while walking on different flooring

surfaces (Chapinal et al., 2011). For example, Chapinal et al. (2011) investigated the changes in acceleration between different flooring surfaces and showed a difference in asymmetry of variance of cattle walking on rubber versus concrete flooring, in which the variance of acceleration was higher on concrete than on rubber mats.

The aims of the current study were (1) to describe the characteristics of locomotion behavior of nonlame cows on pasture (gold standard with optimal locomotion comfort), using commercially available high frequency (400 Hz) 3D accelerometers and video-recording; (2) to compare gait characteristics on pasture with those exhibited by cows walking on mastic asphalt or rubber mats, and (3) to determine the effect of claw trimming of the hind limbs on kinematic and kinetic variables in cows walking on mastic asphalt. Our hypotheses were that gait variables were different between pasture and mastic asphalt and between mastic asphalt and rubber, and that claw trimming had an effect on gait variables of cows walking on mastic asphalt.

MATERIALS AND METHODS

Ethics Statement

The study protocol was approved by the animal experimentation committee of the canton of Bern, Switzerland (permission # 25162).

Animals, Housing and Claw Trimming

The study was carried out on 24 dairy cows of an agricultural school (Inforama Rütli, Zollikofen, Switzerland) between January and April. The sample size of 24 cows was calculated to detect an effect size of 0.6 at a power of 80% and a confidence level of 5%. An online calculator for paired *t*-test was used for the sample size calculation (<https://www.anzmtg.org/stats/PowerCalculator/PowerTtest>). The cows were housed in a tiestall facility and kept on rubber mats covered with straw bedding. The cows were allowed daily access to pasture during the grazing season (April to October) and weekly access to an outside yard (mastic asphalt) during the winter feeding season (November to March).

The mean age of the cows was 3.5 yr (range: 2–7.5 yr), the mean lactation number 2 (range: 1–5) and the mean DIM was 164 (4–338) at the beginning of the study. The breeds involved were Holstein Friesian (*n* = 2), Red Holstein (*n* = 17), and Swiss Fleckvieh (*n* = 5). Mean 305-d milk yield was 7,925 kg. Claw trimming was performed according to a standardized protocol by one professional claw trimmer, using an angle grinder (Lischer et al., 2014). All claws were trimmed. Infec-

Download English Version:

<https://daneshyari.com/en/article/5542018>

Download Persian Version:

<https://daneshyari.com/article/5542018>

[Daneshyari.com](https://daneshyari.com)