



Influence of manure scrapers on dairy cows in cubicle housing systems



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ABSTRACT

Manure scrapers are widely used in dairy cow loose-housing systems. In order to evaluate the effects of the scrapers on the cows, we assessed their impact on the animals' cardiac activity, feeding behaviour, and the behavioural reactions of cows confronted with different types of scrapers. In part I of the study, we measured cardiac activity (mean R–R interval and RMSSD, a parameter of heart-rate variability) whilst observing the behaviour of 29 focal cows on three farms during situations with and without active manure scrapers. Lower RMSSD values were observed during scraping events while cows were either lying, standing or walking in the alleyway, standing completely in the lying cubicle, or standing half in the lying cubicle ($P=0.03$), but only tended to differ while directly confronted with the scraper ($P=0.06$). This indicates that dairy cows experienced at least some mild stress during manure-scraping events. In part II, the feeding behaviour of 12 cows on each of two farms was recorded by means of a jaw-movement sensor and compared between situations with the manure-scraping event following forage provision either within or outside the main daily feeding period (i.e. within 1 or after 2 h from forage provisioning, respectively). The duration of night-time feeding ($P=0.049$) and the number of feeding bouts ($P=0.036$) were higher when a manure-scraping event took place within the main daily feeding period, indicating that the cows' feeding behaviour had been disturbed. In part III, we observed the cows' behaviour on 15 farms during eight manure scraping events per farm, where each of five farms had one of three different scraper types. We assessed the cows' immediate reactions when confronted with the scraper. In addition, we recorded the number of animals present in the alleyways before and after the manure-scraping events. The more cows that were present in the alleyways before the scraping event, the lower the proportion of cows showing direct behavioural reactions both with ($P=0.017$) and without ($P=0.028$) scraper contact, and the higher the number of cows that left the alleyways ($P<0.001$). Scraper type did not influence the proportion of cows showing behavioural reactions.

In conclusion, our results show that dairy cows perceive the manure-scraping event negatively in some situations, that feeding behaviour may be disturbed when scrapers are active during the main feeding period, and that cows avoid the scraper during crowded situations.

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1. Introduction

Automatic manure scrapers are standard equipment in dairy cow loose-housing systems with solid floors. Introduced to reduce labour input, they also help to decrease ammonia emissions (Braam et al., 1997). Scrapers are installed in alleyways along the cubicles and the feed barrier, and activated manually or by a timer. Two types of manure scrapers are commonly used: straight-bladed scrapers, which span the entire width of the alleyway when moving back and forth; and V-blade scrapers, consisting of two arms that span the alleyway during forward movement and which fold in the middle of the alley during backwards movement. The design and shape of both scraper types vary between manufacturers, but V-blade scrapers are typically not as tall as straight-blade scrapers.

Although manure scrapers are widely used, very few studies have been published on their effects on animal behaviour and on the occurrence of scraper-related claw and leg injuries. Since scrapers span the entire width of the alleyway, at least during forward movement, cows must either step over the scraper or avoid it by leaving the alleyway. Johansson and Sällvik (2001) investigated the influence of different types of manure scrapers on the behaviour of dairy cows, and found that there were fewer behavioural disturbances (e.g. movement away from the scraper, slipping) when cows were faced with a low V-blade scraper as opposed to a higher straight-blade scraper. Recording cow behaviour on two floor types, Stefanowska et al. (2001) reported that most incidents involving stumbling were provoked by the moving scraper. In a study of 205 dairy herds, Barker et al. (2010) found that the use of manure scrapers was associated with increased lameness in the animals. In contrast, a more recent study found that increased scraping frequency reduced the risk of severe lameness (Chapinal et al., 2013). Finally, in a survey of 360 Swiss farmers (Steiner and Keck, 2000), 8% reported scraper-related claw and leg injuries in dairy cows.

The aim of the present study was to assess the potential welfare implications of using manure scrapers by investigating their effects on the behaviour and cardiac activity of dairy cows evidencing behavioural disruptions and stress. The study consisted of three parts. In part I, we measured the cows' heart-rate and heart-rate variability (von Borell et al., 2007) in situations with and without an active manure scraper expecting that heart-rate would be higher and heart-rate variability lower when cows performed a given behavioural pattern in situations without and with scraper movement, respectively. In part II, we compared the cows' feeding behaviour when manure scraping took place either within or outside of the main daily feeding period assuming that the cows' feeding behaviour would be disrupted if scraping closely followed the provision of fresh feed. In part III, we assessed behavioural reactions of cows confronted with different types of scrapers and at scraping times to which the cows were either used to or not anticipating that a higher proportion of cows would have contacts with larger scrapers and a higher proportion of cows would show behavioural reactions to the scraper and would be involved more often in critical situations at

a time of day when the cows are not used to a scraping event.

2. Part I: effects of scrapers on cardiac activity

2.1. Materials and methods

2.1.1. Animals and housing environment

Part I was carried out on the experimental farm of Agroscope Reckenholz-Tänikon Research Station ART in Tänikon, Switzerland, and on two Swiss commercial farms. Detailed information on the stables, herds and scrapers is given in Table 1.

2.1.2. Data collection

Ten cows on each farm were selected from the lactating herd as focal animals for behavioural observations and the measurement of cardiac activity in situations with and without an active manure scraper. The ten cows were a random sample of the healthy animals (i.e. those with no obvious lameness, acute mastitis or signs of metabolic diseases such as ketosis or acidosis) on each farm based on the information of the farmers. The focus was on healthy cows as it could be expected that reactions are even more extreme when cows are not as mobile e.g. due to lameness. One cow was dropped from the evaluation because it became obvious during observations that this cow was lame. The focal cows were fitted with a heart rate measurement device and marked individually with cattle markers to help distinguish them on video recordings. To detect possible differences in the influence of manure-scraping events on the cardiac activity of cows with more or less experience of a manure scraper, we differentiated between two types of cows: multiparous ($N=21$, average number of lactations 3.7) and primiparous ($N=8$: 2, 2 and 4 on each of the three farms).

Cardiac activity was recorded telemetrically with Polar™ heart-rate devices (Type S810i, Polar Elektro Oy, Finland). The two electrodes were positioned on the cows' left side between two ribs at the height of the scapula and ventral to the elbow with a damp sponge between skin and electrode, and were held in place by a horse chest-strap. After measurement, data were transmitted to a computer via a serial interface, each interval to be used in the analysis (lasting either 30 or 60 s; see below) was checked for measurement errors, and corrected using the correction mode of the Polar™ software (Polar Equine 4.0) if the error rate was below 5% (Mohr et al., 2002; Hagen et al., 2005). Data sequences with over 5% errors were discarded. For each 30 s interval mean interbeat interval (mean R–R intervals: inverse of heart-rate) and a parameter of heart-rate variability (RMSSD: root mean square of successive differences of interbeat intervals) was calculated. It has been shown in sheep that intervals as short as 10 s can reliably detect patterns in heart rate and heart rate variability (Reefmann et al., 2009). The cows' behaviour was video-recorded with a mobile camera at the same time as cardiac activity was measured.

Cardiac activity and cow behaviour were recorded during ten scraping events on each farm, as well as during

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