Short Communication: Usage of Mechanical Brushes by Lactating Dairy Cows

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ABSTRACT

The objective of this experiment was to investigate how the provision of a mechanical brush affects the grooming (scratching) behavior of group-housed dairy cattle. To do this, we compared the grooming behavior of 72 dairy cows, split into 6 groups of 12, in the absence of a brush (control) and when provided with a mechanical brush (experimental). We analyzed the duration and frequency of scratching on pen objects (wall and water trough) and on the mechanical brush between the control and experimental treatments. Further, we compared the relative frequency of scratching on parts of the cow's body (head, neck, back, tail, and thigh) between the control and experimental treatments. Within 24 h of installation of the mechanical brush, 56.9% of the cows utilized the brush. Within 7 d, 93.0% of cows used the brush, and by the end of the treatment period, all but one of the cows had used the brush. When the mechanical brush was added to the pen, cows dramatically increased the total time spent scratching by 508% and the frequency of scratching events by 226%. These increases were primarily driven by use of the mechanical brush, which accounted for 91.1% of total scratching time and 79.8% of scratching events. When cows were provided with the mechanical brush, they decreased the frequency of scratching their heads, increased the frequency of scratching on their necks, backs, and tails, and tended to decrease the frequency of scratching their thighs. In conclusion, the results of this study show that the use of a mechanical brush makes it easier for cows to groom themselves, particularly in places that are hard to reach by the cow. This may help satisfy this natural behavior and keep them clean, as well as possibly reducing frustration or stress due to boredom when housed in freestall barns.

Key words: grooming, scratching, mechanical brush, dairy cow

All farm animals, especially horses, pigs, and cattle, perform grooming as part of their natural behavior (Ewing et al., 1999). The primary function of grooming is body care, including cleaning and sanitation (Brownlee, 1950; Simonsen, 1979; Ewing et al., 1999). Grooming behavior is thought to help animals remove mud, feces, urine, insects, and parasites and, thus, reduce their risk of disease (Simonsen, 1979; Fraser and Broom, 1997; Ewing et al., 1999).

Self-grooming by cattle often involves licking with the tongue, scratching with their hind feet, scratching with their horns, and swatting with the tail in an effort to clean all areas of their bodies that they can reach (Brownlee, 1950; Simonsen, 1979). To reach inaccessible parts, such as the head, neck, back, and hind quarters, cattle will often scratch themselves on inanimate objects. In extensive production systems, cattle will often make use of environmental items to scratch on, such as branches, bushes, trees, fences, and posts, particularly for areas of the body inaccessible to the mouth, tongue, and feet (Brownlee, 1950; Simonsen, 1979; Fraser and Broom, 1997; Ewing et al., 1999).

Grooming is not only a natural behavior, but it also appears to be a very important behavior for cattle. Bolinger et al. (1997) demonstrated that dairy cows showed increased grooming behavior following periods of being restrained. These researchers noted that this was one of the first behaviors engaged in directly after being released, providing evidence that grooming is an important behavioral need of the cow. It has been suggested that the denial of normal grooming behavior can lead to abnormal behaviors (Ewing et al., 1999). An explanation for this may be that there is not enough opportunity to allow for a full range of grooming behavior, as suggested by Wilson et al. (2002) for beef feedlot environments. Wood-Gush and Beilharz (1983) suggested that the lack of stimulation of animals in bare environments leads to boredom, which can result in abnormal behavior. These authors demonstrated that providing environmental enrichment for the animals could reduce boredom.

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A grooming brush is an example of an environmental enrichment device that allows cattle to perform grooming behavior (Wilson et al., 2002). In the mid 1980s, automated mechanical brushes for dairy cows were introduced (Georg and Totschek, 2001). These brushes are equipped with a mechanical switch that can be activated by the cow and allow for repeated brushing activity. Such a mechanical brush makes it easier for cows to satisfy their natural grooming behavior, which may reduce frustration or stress due to boredom in intensive housing systems (Georg and Totschek, 2001). There is little previous research investigating grooming behavior in dairy cattle housed in a freestall barn with or without the provision of enrichment devices. To date, the only published report describing how dairy cows use mechanical brushes is the descriptive study by Georg and Totschek (2001).

Therefore, the objective of this experiment was to investigate how the provision of a mechanical brush affects the grooming behavior of group-housed dairy cattle. To do this, we compared the grooming behavior of dairy cows in the absence of a brush (i.e., scratching on physical structures within the pens) and when provided with a mechanical brush.

Seventy-two lactating Holstein dairy cows were used in this study. The animals were 41.0 ± 2.6 (mean $\pm$ SD) DIM at the beginning of the data collection period and had an average milk yield of 47.2 ± 0.7 kg/d over the course of the experiment. The cows were housed in a freestall barn located at The University of British Columbia Dairy Education and Research Centre (Agassiz, BC, Canada) and were managed according to the guidelines set by the Canadian Council on Animal Care (1993). Cows were fed twice daily a TMR consisting of 21.5% grass silage, 14.6% corn silage, 32.3% corn and barley, 22.5% protein mash, 5.6% alfalfa hay, and 3.5% grass hay on a DM basis. The composition of the TMR was 46.9% DM and contained, on a DM basis, 18.7% CP, 18.5% ADF, 33.9% NDF, 0.95% Ca, and 0.5% P. Water was provided ad libitum. Cows consumed their feed from a feed alley with access via a pendulous feed-rail and had 0.61 m of feeding space per animal. Animals were milked between 0500 and 0530 h in the morning and between 1700 and 1730 h in the afternoon and were fed at approximately 0630 and 1530 h each day.

The animals were divided into 6 equal groups of 12 cows, balanced according to DIM (41.0 ± 2.6 ; mean $\pm$ SD) and average parity (3.6 ± 0.2). Each group was subjected to a control treatment (no mechanical scratching brush) and an experimental treatment (mechanical scratching brush added to the pen). Two groups were tested with both treatments in each of 3 successive 28-d periods. During the first week, the cows adapted to their new group. During the second week,

the behavior of the cows was recorded as a control. In wk 3, a mechanical scratching brush (Luna cow brush, Lely Industries, NV, Maasland, the Netherlands) was introduced to the pens and remained with the cows for 2 wk.

For each period, the 2 groups of cows were kept in similar pens. Each experimental pen (width = 7.38 m and length = 13.50 m) contained 12 freestalls configured in 3 rows. Two rows faced one another, were open at the front ("head-to-head"), and had a bed length of 2.40 m. The third row of freestalls faced a cement wall, and these stalls were 0.30 m longer to allow more space for getting up and lying down. All freestalls measured 1.20 m wide from center to center, were separated by Artex Y2K dividers (Artex Fabricators Inc., Langley, BC, Canada) and included a neck rail that was 1.14 m above the stall surface. Stalls were deep bedded with 0.40 m of sand. Beside the row of head-to-head stalls was a crossover alley (width = 2.6 m and length = 2.4 m), which was separated from the stalls by a 0.9-m-high cement wall. On the opposite side of the cement wall, a steel water trough (1.8 m long, 0.4 m wide, and 0.4 m deep) was located in this crossover alley. For the experimental treatment, the mechanical brush was positioned in the crossover alley by attaching it to a vertical steel support located in the center of the cement wall adjacent to the stalls. The brush was attached at a height so that the bottoms of the bristles were 1.5 m from the floor when at rest, but the brush was on a pivoting arm to accommodate cows of differing heights.

The grooming behavior of the cows was recorded during the control treatment (wk 2) and the experimental treatment (wk 3 and 4) using time-lapse video equipment. The animals were videotaped 24 h/d using a video camera (Panasonic WV-BP330, Osaka, Japan), a time-lapse videocassette recorder (Panasonic AG-6540), and a video multiplexer (Panasonic WJ-FS 416). For each pen, the video camera was located 7.6 m above the crossover alley where the water trough and mechanical brush were located. From this position, the video camera only recorded the activities that occurred in the crossover alley. Red lights (100 W, <5 lx) were used to facilitate recording at night. Individual animals were identified with unique alphanumeric symbols made with hair dye (Clairol's Nice and Easy #122, Natural Black, or Clairol's L'image Maxiblonde, depending on hair color; Clairol, Stamford, CT) on the back.

Munksgaard and Simonsen (1996) defined grooming for dairy cattle as self-licking any part of the body or scratching the body against housing objects. For this study, we were unable to accurately record all events of self-licking, self-scratching, and social grooming due to use of video recordings. Moreover, we were primarily interested in how the addition of the mechanical brush

influenced the use of inanimate objects by the cows for scratching behavior. Therefore, we only considered grooming as scratching against pen objects (in the cross-over alley) and the mechanical brush. Videotapes were watched continuously and for each scratching event, we recorded the cow involved, the object used for scratching (wall and water trough), the location on the body of the cow being scratched (head, neck, back, tail, and thigh), and the time and duration of the event. These data were used to calculate the duration and frequency of scratching events per cow per day. We also recorded the length of time it took the cows to use the mechanical brush after it was added to the pen and the number of displacements from the mechanical brush. A displacement was noted when physical contact from an actor (e.g., butt or push) resulted in the complete stoppage of scratching by a reactor.

We analyzed the duration and frequency of scratching on pen objects (wall and water trough) and the mechanical brush between the control and experimental treatments. Furthermore, we compared the relative frequency of grooming on parts of the cows' body (head, neck, back, tail, and thigh) between the control and experimental treatments. For all analyses, the pen was considered as the experimental unit, with measures from multiple days and cows averaged to create one observation per pen per treatment. Treatment effects were analyzed using the MIXED procedure of SAS (SAS Institute, 1999). The model included the fixed effect of treatment, the random effect of pen, and the residual error. To test whether cows changed their behavior with the mechanical brush over time, we compared the data from the first and second experimental weeks (the weeks that the cow had the mechanical brush). Because no differences were detected, data from these weeks were combined and are presented together.

Within 24 h of installation of the mechanical brush, 56.9% of the 72 cows utilized the brush. Within 7 d, 93.0% of cows used the brush, and by the end of the treatment period, all but one of the cows had used the brush. The average time it took cows to utilize the brush was 45.5 ± 64.1 h (mean $\pm$ SD; 1.9 ± 2.7 d). In the observational study by Georg and Totschek (2001), 79% of 48 experimental animals used the mechanical brush within the first day, and by 1 wk, all the animals had used the brush. Although it appears that the cows in the present study took a little longer to utilize the brush initially, almost all had used the brush after 1 wk, similar to the results of Georg and Totschek (2001). We also looked at the number of displacements from the brush to see if the cows were actively competing for access to the brush. The number of displacements from the brush was 0.12 ± 0.39 (mean $\pm$ SD) displacements/cow per day. Compared with a food resource, such as

Table 1. Frequency and duration of grooming (scratching) on pen objects (wall and water trough) and the mechanical brush¹

Grooming	Treatment ²		SE	P
	Control	Brush		
Duration, min/d				
Wall	0.81	0.44	0.16	0.02
Water trough	0.41	0.22	0.08	0.02
Brush	—	6.76	—	—
Total scratching	1.22	7.42	0.57	<0.001
Frequency, visits/d				
Wall	1.63	1.22	0.28	0.12
Water trough	1.33	0.73	0.17	0.02
Brush	—	7.71	—	—
Total scratching	2.96	9.66	0.84	<0.001

¹Data were averaged for 7 d for the control treatment and 14 d for the experimental treatment for 6 groups of cows (12 cows per group).

²Treatments: control treatment = no mechanical scratching brush; brush = mechanical scratching brush added to the pen.

feed, where a typical number would be 9.7 displacements/cow per day (DeVries and von Keyserlingk, 2006), there appeared to be little competitive pressure to utilize the brush. This is likely due to the low individual usage time by the cows relative to the time each day that cows were able to engage in this behavior. It could be speculated that the competitive pressure would increase with an increase in the number of cows per brush.

During the control period the cows primarily scratched themselves on the wall and the water trough (Table 1). When the mechanical brush was added to the pen, the cows not only dramatically increased the total time spent scratching by 508%, but also increased the frequency of scratching events by 226%. The change in scratching duration was driven by a decrease in time spent scratching on the wall and water trough combined with a dramatic increase in time (91.1% of total scratching time) scratching on the brush. Although the change in frequency of scratching events was partly caused by a decrease in scratching events on the wall, it was largely driven by an increase in the number of visits (79.8% of scratching events) to the mechanical brush.

Although we observed a longer latency to use the brush initially than that reported by Georg and Totschek (2001), the cows in the present study had a higher visit frequency (Table 1). Unfortunately, Georg and Totschek (2001) did not report the duration of brush use per visit. In a study by Munksgaard and Simonsen (1996), the total grooming time by dairy cows was reported to be 5 min/d. In that study, grooming was defined as self-licking any part of the body or scratching the body against the fixtures of the stall. It is interesting to note that our cows spent more time grooming with the brush (Table 1) despite the fact that we did not

include self-licking in our definition of grooming. However, the cows used in the Munksgaard and Simonsen (1996) study were housed in tie-stalls and thus were tethered, which may have limited their ability to perform natural grooming behaviors (Simonsen, 1979). It could be postulated that mechanical brushes may be important for exercise yards for tie-stall cows to allow them to fulfill their grooming behavior needs.

In a study by Krohn (1994) on the behavior of loose-housed dairy cows, 5.7 out of 23.9 daily events of grooming and 2.3 out of 6.2 min/d of grooming were classified as rubbing against equipment. This included rubbing any part of the body against equipment in the stable or trees in the yard. Understandably, these numbers are higher than that seen in the present study for scratching/rubbing against pen objects (Table 1), because we only recorded those events that occurred in the vicinity of the crossover alley where the scratching brush was located. Interestingly, the cows in our study had dramatically higher scratching frequencies and durations once the mechanical brush had been added to the pen. This seems to indicate that the mechanical brush allowed the cows to satisfy more of their natural grooming behavior. The majority of other grooming events and time spent grooming reported by Krohn (1994) comprised licking parts of the body. Even though this was not recorded in the present study, it can be assumed that a similar proportion would have occurred as licking because this behavior has been described as one of the primary methods used by cattle for self-grooming (Brownlee, 1950; Simonsen, 1979).

When cows were provided with the mechanical brush, they also changed the frequency at which they scratched the various parts of their bodies (Figure 1). In particular, they decreased the frequency of scratching their heads ($SE = 3.6$; $P < 0.001$), increased the frequency of scratching on their necks ($SE = 2.0$; $P = 0.003$), backs ($SE = 1.2$; $P = 0.002$), and tails ($SE = 0.7$; $P < 0.001$), and tended to decrease the frequency of scratching their thighs ($SE = 0.8$; $P = 0.09$). These changes can be explained by the increase in scratching using the brush and decrease in scratching on other pen objects. These results indicate that the mechanical brush allows for more scratching of hard-to-reach places on the cow's body (i.e., neck, back, and tail), which the cow has difficulty accessing by either her tongue, feet, or tail, or by rubbing on pen objects. Although we did not record cow cleanliness, farm staff did note that the cows appeared to be much cleaner when they had access to the brush. We encourage further research in this area because improved cleanliness may help decrease diseases (LeBlanc et al., 2006). Grooming may also be related to stress in dairy cattle. It has been suggested that high levels of self-grooming

Figure 1. Relative grooming (scratching) frequency at the head, neck, back, tail, and thigh on A) pen objects including wall and water trough (control treatment) and B) pen objects and a mechanical brush (experimental treatment). Data were averaged for 7 d for the control treatment and 14 d for the experimental treatment of 6 groups of cows (12 cows per group).

may indicate that this is a displacement behavior (Krohn, 1994), occurring because the animal is stressed. Alternatively, it has been suggested that grooming is an important behavioral need of the cow (Bolinger et al., 1997) and the restriction of this behavior can be

stressful, leading to abnormal behaviors (Ewing et al., 1999). It is not known whether high usage of the mechanical brush is in response to stress or if it is actually reducing stress that may have been associated with limited grooming ability before the addition of the brush. Therefore, we encourage further research to determine the relationship between stress levels and mechanical brush usage in dairy cattle.

In conclusion, the results of this study show that the use of a mechanical brush makes it easier for cows to groom themselves, particularly in places that are hard to reach. This may not only help satisfy this natural behavior and aid in cow cleanliness, but, as suggested by Georg and Totschek (2001), also reduce frustration or stress due to boredom when animals are housed in intensive production systems.

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