SHORT COMMUNICATION

Do Horses Prefer Certain Substrates for Rolling in Grazing Pasture?

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ABSTRACT

We assessed whether rolling damage by grazing horses could be reduced by constructing areas assigned for rolling. A group of horses were enclosed in a paddock with and without rolling areas made of dry soil, sand, and straw. Their behavior was recorded for 1 week in the paddock without any treatment (control paddock). Then the horses were moved to another paddock with the rolling areas (rolling paddock). After a 3-week familiarization period, horses were observed for 1 week. In the rolling paddock, the frequency and time spent rolling were significantly greater in rolling areas than in nonrolling areas. Horses significantly preferred the soil rolling area than sand and straw ($P < .05$). Although rolling was considered the most relevant body care behavioral element, the effects of the substrate in rolling areas on other body care behavioral activities, such as mutual and self-grooming, also were investigated. The frequency and duration of mutual grooming and the duration of self-grooming decreased significantly in the rolling paddock compared with the control paddock ($P < .05$). Hence, offering a rolling area encourages horses to roll in these areas and keeps the pasture in good condition; therefore, grazing time can be increased, with less reliance on supplementary feed.

Keywords: Grazing horses; Mutual grooming; Rolling; Self-grooming

INTRODUCTION

Horses feed mainly on grass. A productive, well-managed pasture can provide most of a horse's nutritional requirements, including protein, vitamins, and minerals. Moreover, horses held in confinement in a stall without the opportunity to exercise or interact socially show a compensatory increase in activity when released into pastures or paddocks.[1] Therefore, a high-quality pasture can be not only an excellent and inexpensive source of feed, but also a place for exercise, rest, and exposure to fresh air and sunlight.[2] Horses that graze in well-maintained pastures will be healthier and stronger than those that graze in poorly managed pastures.[3] In addition, grazing strategies that minimize pasture damage can greatly extend the period over which adequate pasture is available for horses without the need for additional hay. Worn-out pastures not only supply little or no feed but are associated with horse parasites.[3] Furthermore, bare patches can lead to respiratory problems (from dust), skin problems (from mud), and general poor health for all inhabitants of the property, including humans.[4] All of these increase the total cost of keeping horses.

Many horse paddocks have bare patches and erosion because maintaining good grass cover is difficult when horses roll on and destroy the grass. Rolling may be related to coat care or general comfort[5] and is the only way a single horse can rub the dorsal surface of the body. Rolling plays a very important role in horse health by stretching muscles in the spine, neck, barrel, flanks, and buttocks, which helps maintain flexibility and strength.[6] Horses also roll to ease the irritation of sweat by drying the sweat with dirt. This dirt also acts as an extra layer of protection against biting insects.[7]

Rolling, however, causes as much damage to the land as grazing, but because the behavior may be socially facilitated (as with yawning in humans, rolling of one horse stimulates the rolling of others),[7] restricting rolling to certain areas of a pasture may be possible. Hence, providing a special rolling area could help improve the management of farms with limited land. This study investigated whether rolling behavior by horses could be encouraged by constructing specific rolling areas and whether rolling areas affected other related behaviors such as mutual and self-grooming.

MATERIALS AND METHODS

Animals and Housing

Four Kiso horses (native Japanese horses), three females and one gelding, were used in this study. Their age and

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weight ranged from 3 to 19 years old and 372 to 462 kg, respectively. The horses were fed two times (8:30 AM and 4:30 PM) per day. Their daily diet consisted of a 0.2-kg hay cube, 0.2 kg barley, and 3 kg hay (orchard grass or timothy), which met the nutrient requirements of the National Research Council. Water was always available throughout the day. Horses were left in the paddock for 7 hours (9:00 AM to 4:00 PM) every day, followed by grooming for 30 minutes. Then they were moved to individual stalls (3.6 × 3.5 m) with vertical bars spaced 0.08 m apart separating neighboring horses from 4:30 PM to 8:30 AM the next day. The bars allowed visual and auditory communication between stallions, and tactile communication through the bars with at least one neighbor, but no full-contact interactions. All experimental procedures for the use and care of animals in the current study were approved by the Animal Care Committee of the Faculty of Agriculture at Shinshu University.

Paddock Management

The pasture was divided into two separate experimental paddocks of equal size (60 × 120 m), in which orchard grass dominated. Horses grazed a new paddock for approximately 2 months when the pasture plants are 5 to 6 inches tall, and then were moved to another when the shortest areas of the pasture had been grazed to a height of 2 inches. Grazing to below 2 inches weakens and thins stands, allowing weeds to invade. Rotating the grazing pattern keeps the grasses growing more vigorously and increases the carrying capacity per acre.

Experimental Procedure

The study was performed at the Education and Research Center of Alpine Field Science, Faculty of Agriculture, Shinshu University, over a period of 5 weeks. Horses were observed while grazing the paddock without rolling areas (control paddock) for 1 week and then moved to another paddock with rolling areas (rolling paddock) for a 3-week familiarization period, after which they were observed for 1 week. The observation period for all horses in both paddocks was 6 consecutive days (Monday to Saturday). To investigate the preferred substrate for rolling, three different areas were constructed: dry soil, sand, and straw, each 25 m^2 (5 × 5 m). The first rolling area was made by removing grass and replacing it with soil, and the other areas were built by adding sand and straw with depths of 15 and 20 cm, respectively. Water was provided in the corner of the paddock, as shown in Figure 1.

Behavioral Observations

The frequency and duration of the rolling and mutual and self-grooming were recorded (Table 1) from 9:00 AM to 12:00 noon and from 1:00 PM to 4:00 PM daily (from Monday to Saturday) for 2 weeks. These behavioral activities were measured in both paddocks by a continuous animal sampling method during the later observation periods.

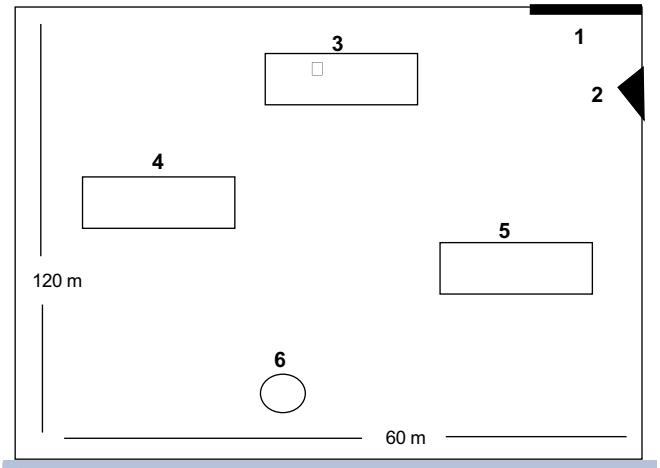

Fig. 1. Location of the rolling areas in the rolling paddock. (1) Entrance of the paddock; (2) Waterbowl; (3) Sand rolling area; (4) Soil rolling area; (5) Straw rolling area; (6) Observer.

Data Analysis

Results were expressed as the mean ± standard error (SE) for each parameter. Analysis of variance followed by Fisher's protected least significant difference test were used to analyze the frequency and duration of rolling. Values of rolling and mutual and self-grooming for the control and rolling paddock were compared with a nonparametric analysis using Wilcoxon's signed-ranks test. A probability level of $P < .05$ was considered significant.

RESULTS

As shown in Table 2, rolling was more frequent but of lesser duration in the rolling paddock than in the control paddock. The frequency and duration of rolling were 0.79 ± 0.13 and 38.75 ± 6.89, and 1.08 ± 0.16 and 32.70 ± 5.59 in the control and rolling paddocks, respectively; these differences, however, were not significant. Horses in the rolling paddock primarily rolled in the rolling areas, and with a similar frequency to rolling in the control paddock (0.79 times). However, the duration of rolling in rolling areas in the rolling paddock (22.70 ± 4.22) was significantly less than that in the control paddock (38.75 ± 6.89; $P < .05$). Moreover, in the rolling paddock, rolling frequency and duration increased significantly ($P < 0.05$) in rolling compared with nonrolling areas (0.79 ± 0.14, 22.70 ± 4.22, and 0.29 ± 0.09, 10.00 ± 3.45, respectively).

As shown in Table 3, the frequency and duration of rolling in soil were significantly higher ($P < .05$) than those in sand or straw. Furthermore, the frequency and duration of

Table 1. The studied behavioral parameters

Behavior	Description
Rolling	Rubbing of the dorsal body surface against the ground.
Mutual grooming	A pair of horses stands head to tail, scratching one another with their top teeth, particularly along the backline and neck, using their tails to keep flies out of one another's eyes.
Self-grooming	Includes tail swishing and rubbing against objects such as trees or fence posts, or rubbing one part of the body against another.

rolling in grass (the rest of the paddock) were less than those in soil but more than those in sand or straw; these differences were insignificant except the duration between grass and straw, which was significant ($P < .05$). In addition, most rolling occurred during the morning period (8:30 AM to 12:00 noon), and decreased thereafter. The frequency of rolling in the morning was 0.25 ± 0.09, 0.45 ± 0.07, 0.20 ± 0.11, and 0.08 ± 0.05, and in the afternoon was 0.04 ± 0.04, 0.05 ± 0.05, 0 ± 00, 0 ± 00 in the grass, soil, sand, and straw, respectively; these differences were significant ($P < .05$). Also, the duration of rolling in the morning was 8.75 ± 3.36, 13.54 ± 2.59, 6.66 ± 3.27, and 1.66 ± 1.05 and in the afternoon was 1.25 ± 1.25, 0.82 ± 0.83, 0 ± 00, and 0 ± 00 in the grass, soil, sand, and straw, respectively; these differences were significant ($P < .05$).

Although rolling is the most relevant to the study, other behavioral activities were considered, such as mutual and self-grooming. As shown in Table 4, the frequency and duration of mutual grooming in the control and rolling paddocks were 3.70 ± 0.79 and 141.75 ± 52.05, and 1.91 ± 0.45 and 46.95 ± 14.14, respectively; these differences were significant ($P < .05$). Furthermore, horses performed more frequent self-grooming in the control paddock than in the rolling paddock, although the difference was not significant. However, horses spent significantly more time self-grooming in the control paddock than in the rolling paddock ($P < .05$; 6.41 ± 1.66 and 3.08 ± 0.77, respectively). The average frequency and duration of these behavioral activities (rolling and mutual and self-grooming) in the control and rolling paddocks were 1.89 ± 0.32 and 62.30 ± 18.57, 1.30 ± 0.17, and 27.58 ± 5.45, respectively; these differences were significant ($P < .05$).

DISCUSSION

The horse is a natural grazing animal, and sound grazing management can decrease feeding expenses, stable cleaning, and other chores, and leave more time for horses to exercise and engage in other recreational activities. In addition, well-managed pastures help keep horses healthy.[2]

The current study indicated that horses in the rolling paddock mostly rolled in the rolling areas, and with a similar frequency to rolling in the control paddock (0.79 times). However, the duration of rolling decreased significantly ($P < .05$) in the rolling paddock compared with the control paddock. Of course, this saves more time for horses to perform other beneficial behavioral activities. In the rolling paddock, horses rolled more often and consequently spent more time rolling in the constructed rolling areas than in nonrolling areas. This indicates the absolute preference for presence of rolling areas. Thus, building rolling areas encourages horses to roll in these contained areas, thereby reducing damage to pastures. Consequently, high-quality pasture can be the best and least expensive source of feed for horses. In addition, well-kept pastures provide the best place for horses to exercise, rest, and have access to fresh air and sunlight.

Each morning, immediately after the horses entered the rolling paddock, they would visit the soil area for rolling more often than the sand and straw areas. Horses may have preferred the soil because it was similar in nature to where they rolled in the control paddock, and consequently we did not find a significant difference between soil and grass (the rest of the paddock). Furthermore, soil is harder than sand and straw, which could provide more scratching and muscle stretching. At the same time, sand exposed to sunlight may become hot, especially at noon, and straw may be too soft to serve as a rubbing substrate.

In both the control and rolling paddock, horses rolled more often in the morning than in the afternoon. These results indicate that while in captivity in their stalls, they may accumulate dirt and dried fecal matter, and therefore may

Table 2. Frequency and duration of rolling in the control and rolling paddocks

	Control Paddock	Rolling Paddock		
Measurement	**Control Area (CA)**	**Rolling Area (RA)**	**Nonrolling (NRA)**	**Area Total (RA + NRA)**
Frequency (no./ day)	0.79 ± 0.13[a]	0.79 ± 0.14[a]	0.29 ± 0.09[b]	1.08 ± 0.16[a]
Duration (seconds/bout)	38.75 ± 6.89[a]	22.70 ± 4.22[b]	10.00 ± 3.45[c]	32.70 ± 5.59[a]

CA, control area; RA, rolling in rolling areas; NRA, rolling in nonrolling areas. Each value represents the mean (±SE, n = 4).
[a,b,c]Means in rows with different letters are statistically different at $P < .05$.

Table 3. Frequency and duration of rolling in different rolling areas

Area	Frequency (No./6 Hours)			Duration (Seconds/Bout)		
	Morning	**Afternoon**	**Total**	**Morning**	**Afternoon**	**Total**
Grass	0.25 ± 0.09*	0.04 ± 0.04	0.29 ± 0.09[a,b,c]	8.75 ± 3.36*	1.25 ± 1.25	10.00 ± 3.45[a,b]
Soil	0.45 ± 0.07*	0.05 ± 0.05	0.50 ± 0.09[a]	13.54 ± 2.59*	00.82 ± 0.83	14.36 ± 2.80[a]
Sand	0.20 ± 0.11*	00 ± 00	0.20 ± 0.11[b]	6.66 ± 3.27*	00 ± 00	6.66 ± 3.27[b]
Straw	0.08 ± 0.05*	00 ± 00	0.08 ± 0.05[c]	1.66 ± 1.05*	00 ± 00	1.66 ± 1.05[c]

Each value represents the mean (±SE, n = 4).
*There are significant differences between morning and afternoon ($P < .05$).
[a,b,c]Means in columns with different letters are statistically different at $P < .05$.

Table 4. Frequency and duration of rolling and mutual and self-grooming in the control and rolling paddocks

Area	Frequency (No./6 Hours)		Duration (Seconds/Bout)	
	Control Paddock	**Rolling Paddock**	**Control Paddock**	**Rolling Paddock**
Rolling	0.79 ± 0.13[a]	1.08 ± 0.16[a]	38.75 ± 06.89[a]	32.70 ± 5.59[a]
Mutual grooming	3.70 ± 0.79[a]	1.91 ± 0.45[b]	141.75 ± 52.05[a]	46.95 ± 14.14[b]
Self-grooming	1.20 ± 0.34[a]	0.91 ± 0.16[a]	6.41 ± 01.66[a]	3.08 ± 0.77[b]
Average	1.89 ± 0.32[a]	1.30 ± 0.17[b]	62.30 ± 18.57[a]	27.58± 5.45[b]

Each value represents the mean (±SE, n = 4).
[a,b]Means in rows for each the frequency or duration with different letters are statistically different at $P < .05$.

immediately engage in rolling to rid their bodies of these nuisances. Alternatively or in addition, rolling could be a way for the horses to decrease stiffness after confinement in a stall without the opportunity to exercise and thereby gain well-being and satisfaction.[8]

Generally, rolling behavior and mutual and self-grooming may be forms of body care.[5] In the current study, our observations showed that the frequency and duration of grooming decreased when the horses were in the rolling paddock compared with the control paddock. These results suggested that the constructed rolling areas were superior to merely rolling anywhere in the paddock (control condition), which in turn influenced other body care behaviors such as mutual and self-grooming. Furthermore, the time saved by performing less body care could be used for other daily activities such as exercising, grazing, and playing, thereby increasing the quality of the time spent in the paddock. Moreover, constructing rolling areas reduces rolling damage and keeps the pasture in good condition; therefore grazing time can be increased, with less reliance on supplementary feed.[9]

CONCLUSION

Constructing rolling areas encouraged horses to roll in those contained areas, in which the horses may have preferred the soil to sand and straw. This preference might be linked to the rubbing power of the soil against body muscles. Furthermore, constructed rolling areas can minimize damage and also greatly extend the period over which adequate pasture is available for horses without the need for additional hay. In summary, it is recommended that rolling areas be provided in the pasture of horses and that these rolling areas be constructed of soil.

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