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BRIEF COMMUNICATION: Behaviour of New Zealand pasture-based cows offered access to free stalls fitted with sand or water beds, compared with cows at pasture

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Keywords: behaviour; free-stalls; bedding; pasture

Introduction

New Zealand dairy cows have typically been grazed on pasture all year round, however intensification of milk production systems has led to increased nitrogen loss into the environment (de Klein & Ledgard 2001; Luo et al. 2007). Limiting the amount of time that cows have access to pasture, particularly during inclement weather, by the use of feed pads or cow housing for parts of the season or day (de Klein 2001), can reduce nitrogen loss into waterways (Christensen et al. 2012). This approach is particularly important in protecting the soil and pasture from treading damage (Arnold 2009) and can allow non-lactating cows to be retained on the dairy unit over the winter or animals to be sheltered from excessive rain, cold and sunshine. Unfortunately, many New Zealand dairy farmers and the majority of cows have little or no experience of cow housing.

This experiment was completed to assess the acceptance and use of differing free stall bed types by adult dairy cows, with no previous experience of housing, and to compare this with cows kept at pasture. The evening and nightly, daytime grazing and overall daily behaviour patterns of these cows are reported and discussed in this brief communication.

Materials and methods

This work was completed in accordance with the ethical procedures of Massey University (MUAEC 11/82), Palmerston North, between November 2011 and May 2012 when the mean temperature was 24 ± 2.1 (Standard deviation) $^{\circ}\text{C}$. A total of 36 adult non-lactating Holstein Friesian and Jersey cross bred dairy cattle between five and 13 years of age were used. They were selected at random from the Massey dairy herds and allocated according to age and live weight to one of three groups of 12 cows, such that the groups were balanced for animal age and live weight.

During the bed comparison periods all groups of cows were grazed for a restricted period of four hours per day between 1100 and 1500 hours, stood on concrete for two hours simulated milking periods from 0900 to 1100 hours and from 1500 to 1700 hours, and housed or grazed for 16 hours from 1700 to 0900 hours. At night Group 1 and Group 2 were housed on free stalls (1.1 m x 2.4 m), while Group 3 was kept at pasture. Housed cows were offered *ad libitum* access

to 10 ± 1 kg of dry matter per cow of grass silage in a feed trough while housed. There was a free-stall distance of 4.5 m equivalent to 0.7 m per cow feeding width at the trough. Initially, cows in Groups 1 and 2 were introduced to free stalls in two adjacent pens that were fitted with 13 free stalls (a total 26 stalls) earth beds, during which cows readily used freestall beds for a period of five consecutive nights between 1700 and 0900 hours. Following this period cows were rested on pasture for five days, while the one pen was fitted with 13 dual chamber water beds (Advanced Comfort Technology Inc., Reedsberg, Wisconsin, USA) and the other was fitted with 13 deep river sand beds with a minimum depth of 20 cm. Twelve cows were offered 13 of the stalls of one bed type and were then offered the alternative bed type. This was achieved by acclimatizing the cows to the night bed type and grazing routine for three days, prior to each period of detailed behavior observation being undertaken over a 24 hour period for the next three consecutive days. This is equivalent to a continuous period of 72 hours in total for each bed type.

After the behavior observations the cows were rested on pasture for five days and then the cows were offered the other pen fitted with the alternative bed type and the acclimatization and observation procedure was repeated. The behavior of all cows in terms of lying, walking, feeding, standing, drinking, standing or lying bouts and the bed used, was recorded manually by scan sampling at five minute intervals during daylight and 15 minute intervals during darkness. Activity meters (Ice TagsTM, IceRobotics, South Queensferry, Scotland) were fitted to seven cows in each group, and used to validate the manual observation data. Much of the behavior data was found to be not normally distributed and was analyzed using the non-parametric Kruskal Wallis procedure in Minitab (Version 16, Minitab Inc, State College, Pennsylvania, USA) with lying surface (water, sand or pasture) type included in the model as a fixed effect. Differences between medians were assessed using individual standard deviations and a confidence interval of 95%.

Results

The cows with access to water beds had significantly lower nightly and total lying time ($P < 0.001$) than when the cows were offered access to

Table 1 Median time \pm standard deviation (hours) spent lying, standing, walking and grazing/feeding, by cows offered access to dual chamber water beds or deep litter sand beds, and compared with pasture for the period overnight between 1700 and 0900 hours. P values in bold indicates significance at ($P < 0.05$). P value in italics indicates approaching significance between $P = 0.05$ and $P < 0.10$.

Period	Activity	Bed type			P value
		Pasture	Sand	Water	
Housed (16 hours)	Lying	10.4 \pm 2.6 ^a	10.4 \pm 2.2 ^a	7.3 \pm 3.5 ^b	<0.001
	Standing	1.5 \pm 2.5 ^b	1.7 \pm 1.4 ^b	2.9 \pm 2.6 ^a	<0.001
	Feeding/grazing	4.0 \pm 0.9 ^a	3.1 \pm 1.2 ^b	3.1 \pm 1.0 ^b	<0.001
	Walking	0.04 \pm 0.04	0.00 \pm 0.04	0.00 \pm 0.06	0.30
Grazing (4 hours)	Lying	0.75 \pm 0.57 ^c	1.17 \pm 0.63 ^b	1.67 \pm 0.62 ^a	<0.001
	Standing	0.33 \pm 0.37 ^a	0.08 \pm 0.31 ^b	0.08 \pm 0.30 ^b	<0.001
	Grazing	2.67 \pm 0.56 ^a	2.50 \pm 0.65 ^a	2.00 \pm 0.65 ^b	<0.001
	Walking	0.12 \pm 0.09	0.12 \pm 0.08	0.12 \pm 0.14	0.84
Total daily (24 hours)	Lying	11.5 \pm 2.8 ^a	11.2 \pm 2.8 ^a	9.6 \pm 3.4 ^b	<0.001
	Standing	5.6 \pm 2.4 ^{ab}	5.6 \pm 1.4 ^b	6.7 \pm 2.7 ^a	<0.001
	Feeding/grazing	6.7 \pm 1.1 ^a	5.6 \pm 1.2 ^b	5.2 \pm 1.1 ^b	<0.001
	Walking	0.42 \pm 0.16	0.42 \pm 0.14	0.50 \pm 0.24	<i>0.08</i>

sand beds and compared with cows kept on pasture (Table 1). In contrast, the total lying time did not differ significantly ($P > 0.05$), between cows kept overnight at pasture compared with cows that had access to sand beds. During the grazing period, the cows offered water beds each night spent significantly less time grazing ($P < 0.001$) and more time lying ($P < 0.001$) than cows offered sand beds or kept on pasture. The time cows spent eating was significantly lower ($P < 0.001$) for cows housed at night and daily ($P < 0.001$), over 24 hours.

Discussion

In this study cows adopted sand beds and free stalls readily (2 ± 0.5 days). The overall daily lying times for all cows in this study (Table 1) were slightly below the 12 hours proposed for lactating cows by Jensen et al. (2005), but very similar to the lying times of 10.9 hours found in recent studies of cow lying times on pasture (Hernandez-Mendo et al. 2007; Olmos et al. 2009; Dalley et al. 2012), and lying hours found in cows housed in free stalls with 11.3 to 11.8 hours on sand (Cook et al. 2004; Norring et al. 2008; 2010), 11.7 hours on mattresses (Cook et al. 2004), 10.6 to 12.8 hours on rubber mats (Norrning et al. 2010) and mattresses (Cook et al. 2004), but above the 8.3 hour daily lying time found on one farm in the South Island of New Zealand, using free stalls fitted with rubber mats (Dalley et al. 2012).

In this study, which was completed during the summer and when the cows were kept on water beds, the lying time was lower than when the cows were kept on sand beds or compared with the cows kept on pasture. The lying times on water beds were within the 7 to 10 hours described by Phillips (2010), who clearly stated that early lactating cows lay for less time than late lactation and dry cows. In this study, when cows were housed on water beds, they lay for significantly

less time each day and spent significantly longer standing while housed on water beds, which has been associated with increased levels of lameness (Cook et al. 2004). Cows housed on water beds spent more time lying during the daytime grazing period and significantly less time grazing during the day. The greater lying times found in cows at pasture and in sand beds were consistent with those of Herlin (1997), Chaplin et al. (2000), Haley et al. (2000), and Boone et al. (2010) who found that cows were more inclined to lie down on softer materials such as sand and mattresses, resulting in increased lying time and a reduction in standing time. The cows in the current study showed a willingness to adopt and lie on sand beds, but when offered water beds these cows were more likely not to use the stalls, lying outside of the stalls or inside the stalls for less time and standing in and outside of the stalls for longer.

This is supported in previous studies, which compared sand and water beds and reported that sand beds had greater occupancy percentages (Wagner-Storch et al. 2003), with sand bedded free stalls being found to have the highest overall percentage (52.9%) of cows lying. The greatest percentage of empty stalls (49.0%) were found in stalls fitted with water beds (Boone et al. 2010).

There is an overall agreement that pasture is considered by cows as a more comfortable surface on which to lie (Hernandez-Mendo et al. 2007), with no difference being observed between time spent standing indoors on sand beds and on pasture (Table 1). Interestingly, standing behaviour of dairy cows changed in response to the type of bed surface used. The duration of standing on sand bed stalls was within the range of standing times reported in Cook et al. (2004) and Manninen et al. (2002), but when cows were offered water beds the standing time was greater compared to those on sand bedded stalls or at pasture. Similarly, a recent study carried out in the USA

reported that cows were observed more frequently standing or lying in the alleys when housed in free stalls fitted with water beds compared with sand beds (Boone et al., 2010). In the current study a reduction in lying time and increase in standing time observed was found in cows kept on water beds, which typically reduced animal productivity and health, particularly increased lameness (Cook et al. 2004; Phillips 2010).

Conclusions

Dry dairy cows transitioning from fully pasture based to partially housed conditions lay on pasture and sand beds for similar periods of time. When cows had access to free stalls fitted with dual chamber water beds, the lying time was shorter and standing time was greater, compared with when the cows had access to deep litter sand beds. Cows with no experience of housing readily and quickly adapted to lying in free stalls. However, the type of free stall bed and lying surface that farmers select is of great importance to the productivity, health and welfare of dairy cattle, due to its direct effect on bed occupancy and the amount of time cows spend lying and standing.

Acknowledgements

Authors would like to acknowledge funding from Pastoral 21, which is a collaborative venture between DairyNZ, Fonterra, Dairy Companies Association of New Zealand, Beef + Lamb, NZ and the Ministry of Business, Innovation and Employment. Its goal is to provide accessible systems-level solutions for profitably increasing pastoral production, while reducing farms' environmental footprint.

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