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Laterality of lying behaviour in dairy cattle

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ABSTRACT

Dairy cattle spend, on average, between 8 and 15 h/d lying down. Our objective was to describe the laterality of lying behaviour and assess several internal and external factors that may affect laterality. Internal factors included time spent and time since eating or lying before choosing to lie down again. External factors included the slope and the amount of bedding on the of the lying surface. The dependent variables were the proportion of time spent lying on left versus right sides (as affected by eating and by the slope of stalls) and the probability of switching sides between two consecutive lying bouts (as influenced by previous lying bouts and the amount of bedding). The proportion of time on the left and right sides matched the mixed pattern in the literature; some groups of cows ($n = 35$, non-lactating, freestall housed) spent more time ($56 \pm 3.0\%$, $P = 0.042$) on their left side, while other groups ($n = 151$, housed either in a freestall barn or at pasture) showed no preference for lying on one side versus the other ($50 \pm 1.2\%$ on left side, $P \geq 0.308$). Laterality while lying was not influenced by eating behaviour or by the slope of the lying surface. Overall, cattle switched sides in 64% of consecutive lying events, more than 50% expected by chance (SE = 0.8%, $P < 0.001$). Switching sides was influenced by previous lying behaviour: cattle were more likely to switch sides if the previous lying bout was either long or recent (1.5 ± 0.33 and $1.1 \pm 0.21\%$ change in probability of switch for every 10 min in the last lying bout and for every 10 min since previous lying event, respectively, $P < 0.001$). Cows were more likely to switch sides when housed on mattresses with more bedding (switched sides in 68, 77, and $97 \pm 10.8\%$ lying events for 0, 1 and 7.5 kg of sawdust bedding, mean $\pm$ SE, $P = 0.042$), possibly because cows had more lying events with shorter intervals between these events when the stall surface was well bedded. The probability of terminating a lying bout was also influenced by the duration of the bout. For example, during the first 10 min of a lying bout, the probability of standing up was only 5% but climbed to approximately 25% when the bout lasted 80 min or more. In conclusion, overall laterality in lying behaviour is shifted to the left in some groups but not others. Eating behaviour has little effect on time spent lying on either side. Cows switched sides between consecutive lying bouts and switching was more likely if the previous bout was either recent or long. Finally, continuous lying may become uncomfortable when bouts are longer than 80 min, and cows may switch sides to alleviate this discomfort.

1. Introduction

The laterality of lying behaviour in cattle has been documented several times in the last century. Some studies have concluded that more time is spent lying on the left side, and others have reported no difference in

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Table 1
Summary of literature about laterality of lying behaviour in adult dairy cattle.

Reference	Time on left side	Statistically different?	Based on 24-h observation?	Individual animals identified?
Arave and Walters (1980)	62–64%	Yes	Yes	Yes
Bao and Giller (1991)	59%	Yes (cows pregnant with twins)	Yes	Yes
Bao and Giller (1991)	48%	No (cows pregnant with singletons)	Yes	Yes
Bryan and Taylor (1938)	48%	No	?	Yes
Ewbank (1966)	51%	Not tested	Yes	Yes
Forsberg et al. (Study 1, 2008)	50%	No	No	Yes
Forsberg et al. (Study 2, 2008)	50%	No	Yes	Yes
Forsberg et al. (Study 3, 2008)	43–61%	Yes, in 9th month of pregnancy	No	Yes
Jackson (1905)	53–61%	Yes	No	No
Phillips et al. (2003)	55%	No	No	Yes
Uhrbrock (1969)	52%	No	No	?
Wagnon and Rollins (1972)	50%	No (AM only)	No	Yes
Wagnon and Rollins (1972)	56%	Yes (PM only)	No	Yes

laterality (Table 1). In some of the studies that report differences in laterality (e.g. Jackson, 1905; Wagnon and Rollins, 1972), individual cows were not identified or followed over a 24-h period; studies with these limitations may not provide a representative sample of lying events. In addition, only a small sub-sample of studies describe the pattern of laterality. For example, Wagnon and Rollins (1972) anecdotally report that cows often switch sides between lying events and Bao and Giller (1991) report that cows switched sides between 50 and 60% of lying events.

In the studies that report differences in laterality while lying, both internal and external factors seem to play a role. Internal factors include rumen fill, comfort, rumination, and pregnancy. Wagnon and Rollins (1972) speculate that cows spend more time on the left side after eating (56% of time on left side in afternoon observations occurring after a meal) to balance the additional weight in the rumen, situated on the left side of the body. Unfortunately, these authors did not record time spent feeding or feed intake. Comfort may also influence the side that cows lie on. Ruminally cannulated dairy cattle spend less time on their left side (30%) compared to intact cows (53% on left side, Grant et al., 1990), possibly because of discomfort associated with the cannula. Pregnancy also influences laterality. Cows in later stages of pregnancy are more likely to lie on their left side (Arave and Walters, 1980; Forsberg et al., 2008) and cows carrying twins are more likely to lie on their left side, compared to cows pregnant with singletons (Bao and Giller, 1991). These differences may also be explained by discomfort: Bao and Giller suggest that the enlarged uterus pushes the rumen further to the left (1991).

External factors also influence laterality of lying behaviour. For example, Arave and Walters (1980) suggest that cows are more likely to lie with their dorsal side uphill. Others have found that laterality differs within the barn for reasons that are not clear (more time on left side in north end of barn, Gwynn et al., 1993).

Over a number of years, we collected information about the laterality of lying behaviour. Experiments were performed on four farms in two countries (Canada and New Zealand), generating a large dataset to explore patterns in laterality. Our objective was to use these datasets to describe the effect of housing condition (pasture vs. freestall) and stage of lactation (dry vs. mid- and late lactation) on the laterality of lying behaviour of dairy cattle. We predicted that cows would spend more time on the left side after eating, particularly if the eating bout was long or recent. In addition, we aimed to describe and the pattern of switching sides between lying events and predicted that cows would be more likely to switch sides if the previous lying bout was long or recent. Our goal was to use patterns in lying bout structure to help understand why cows may switch sides between consecutive lying events. Finally, we predicted that cows would be more likely to switch sides when lying on an uncomfortable surface (e.g. less bedding).

2. Materials and methods

2.1. Time spent on each side

2.1.1. Cows and treatments

Data were pooled from six experiments and information from 186 cows was broken into four groups based on stage of lactation and housing conditions: (1) pregnant, non-lactating cows kept in a freestall barn ($n = 35$ from Tucker and Weary, 2004; Tucker et al., 2005, 2006), (2) mid-lactation cows kept in freestall barn ($n = 27$ from Experiment 2 in Tucker et al., 2004a), (3) mid-lactation cows kept at pasture ($n = 60$ from Experiment 2 in Tucker et al., 2007), and (4) late-lactation and non-lactating cows kept at pasture ($n = 64$ from Tucker et al., 2009). We specifically tested the effect of freestall slope (3% slope in alleyways and base of freestalls) with cows in Group 1. Thirteen of these cows were housed in stalls with a 3% slope to the left and 22 cows were housed with stalls with a 3% slope to the right (total $n = 35$).

2.1.2. Measurements

Lying behaviour was measured by continuous observation from video for Groups 1 and 2 and by live observation with 10-min instantaneous scan samples for Groups 3 and 4. At least two 24-h periods were used from each cow (range: 2–10 d of lying information per cow).

A sub-set of these data ($n = 136$ cows; 12 cows from Group 1 and all of Groups 3 and 4) was used to examine if eating behaviour influenced the choice to lie on the right or left side. We considered all lying events in relation to eating and the first lying event after eating. Information