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Faecal Contamination of the Lying Area for Dairy Cows in Different Housing Systems

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Abstract. The hygienic function of a housing system for dairy cows is an important factor for cleanliness and animal welfare. Extensive dirtiness may cause health problems, reduced milk quality and increased work load. In this study, 60 tie-stalls, 56 cubicles and 16 feeding cubicles in the same herd were compared as to hygienic function, i.e. how often can different types of lying areas for dairy cows be expected to be contaminated by faeces? On five days, before morning and afternoon stable work, stalls, cubicles and feeding cubicles were observed and those contaminated with faeces were recorded. The feeding cubicles were found to be the least contaminated lying area followed by cubicles and tie-stalls. Primiparous cows in tie-stalls contaminated their lying area severely while cubicles of primiparous cows were very seldom contaminated. Multiparous cows in cubicles contaminated the lying area while lying, which gave nearly the same contamination level in the morning observation as those in tie-stalls. The high cleanliness of the feeding cubicles was attributed to the concentrates being distributed from an automatic dispenser in the alley, motivating the cows to leave the feeding-cubicle for concentrate feeding together with other reasons to leave the feeding-cubicle either voluntarily or involuntarily and thus, defecation occurred more often in the alley.

Key words: Animal hygiene, tie-stalls, cubicles, feeding cubicles.

INTRODUCTION

The hygienic state of the lying-area is an important factor for the cleanliness and well-being of the cows in a dairy herd. Extensive faecal contamination of stalls or cubicles may cause disturbances in animal health, e.g. mastitis and hoof diseases, and may lead to microbial contamination of milk. Dirty animals also cause extra work with cleaning of stalls and cows before milking. There is a great variation in dairy barn hygiene between herds which depends on the design of stalls, equipment and management (Bakken, 1981).

Cubicle design aims at inhibiting contamination in the lying area by encouraging lying down, lying and rising behaviours, but discouraging standing. Total prevention is, of course, impossible and reasons for variation in cubicle cleanliness are still not completely understood. For tied cows, the situation is complicated. In order to give the animals possibilities to eat, lie down, rest, rise, defecate, urinate and get milked without leaving the stall, the ties must permit a certain freedom of movement (Rom, 1989). Less fixation, however, also means that the cows will defecate more often in the stall. Stall partitions are recommended as means of improving cleanliness, but they may hinder the milker. The feeding-cubicle is a combined eating (with access to a feeding-table) and lying area which makes the feeding cubicles more occupied than the cubicles. Feeding-cubicles offer freedom of movement and exercise for the cows and allow milking to be done in a parlour.

The object of the present investigation was to determine the effects of housing system and parity on the faecal contamination of stall, cubicles and feeding-cubicles during hours when no staff are present in the barn.

MATERIAL AND METHODS

Experimental plan

The experiment was carried out at Alnarp dairy research farm. Within the same herd, dairy cows of the Swedish Friesian breed were housed in cubicles, feeding-cubicles and tie-stalls, respectively.

The hygienic state of totally 60 tie-stalls, 56 cubicles and 16 feeding-cubicles was studied. 35 tie-stalls were occupied by multiparous cows while 25 tie-stalls accommodated primiparous

Table 1. *The lactional stage, feeding, milk production and live weight of the cows on the first day of the study. Dry cows at the start of the study, calved during the study. Mean ± SD*

	Tie-stalls		Cubicles		
	primiparous	multiparous	primiparous	multiparous	Feeding cubicles multiparous
n	25	35	24	27	16
Lactation week	9.2 ± 4.1	10.2 ± 8.0	13.9 ± 5.9	9.5 ± 6.7	11.0 ± 9.2
Dry cows	0	5	0	3	1
Feeding					
Concentrates, kg	6.7 ± 2.0	7.2 ± 3.3	5.2 ± 2.0	9.1 ± 3.4	4.3 ± 2.4
Forage*, kg DM	11.6 ± 0.7	13.2 ± 2.4	12.7 ± 0	13.3 ± 0	10.8 ± 0
Milk production					
kg per day	26.9 ± 4.9	29.0 ± 13.3	22.6 ± 3.5	25.8 ± 10.4	23.0 ± 6.9
Live weight, kg	547 ± 52	643 ± 52	551 ± 29	636 ± 44	582 ± 50

*Forage was alfalfa silage, beet-pump, hay and straw for cows in tie-stalls and cubicles and grass and alfalfa silage, hay and straw for cows in feeding cubicles.

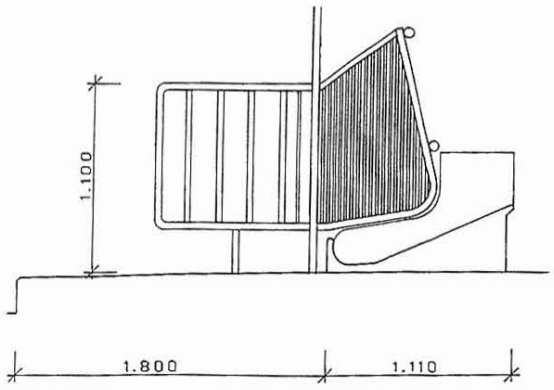
cows. The cows in the loose-housing system were divided into two groups: One group of 27 multiparous cows with one cubicle each and another group with 24 primiparous cows having access to a total of 29 cubicles. The 16 feeding-cubicles housed 16 multiparous cows. Data on lactational stage, feeding, milk production and live weight of the cows are shown in Table 1. Cows in cubicles and feeding-cubicles were given concentrates in automatic dispensers (one dispenser per 12–20 cows) and forage at the feeding table. All cows had 24-hour access to the feeding table. Tie-stalls were 1.3*1.8 m, cubicles were 1.3*2.2 m and feeding-cubicles were 1.2*1.7 m. The floors of the lying areas were covered with rubber-mats. Sawdust was used as bedding in all types of stalls/cubicles. New bedding was provided in each tie-stall twice a day (1–2 kg per day) and in each feeding cubicle once a day (0.5–1 kg per day), while in each cubicle the bedding was provided twice a week (3–4 kg per occasion). Chopped straw (0.5 kg per day and stall) was additionally used in the tie-stalls. In tie-stalls, cows were rather loose-tied with cross-ties. A set of bars above the sloping crib hindered the cows from moving forward. There was also a partitioner between every stall. The design of the three stall-types are shown in Fig. 1. Manure and slurry were mucked out twice daily.

Registrations were made at 05.50 hrs, before the start of morning stable work and at 13.20 hrs, before the start of afternoon stable work, one day per week for five weeks. Cubicles/stalls were recorded as contaminated if a minimum area of 100 cm^2 was covered with faeces.

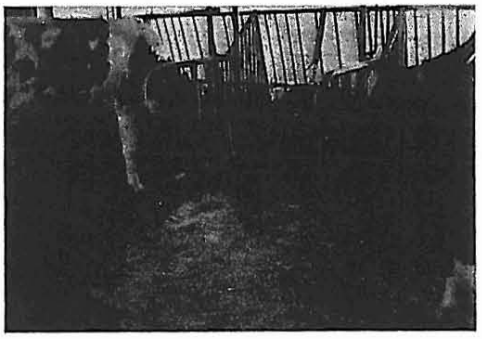
The cubicles and the feeding-cubicles were cleansed twice a day, at milking times, and the tie-stalls were cleansed several times during morning and afternoon stable work at 06.00–09.30 hrs and 13.30–16.50 hrs.

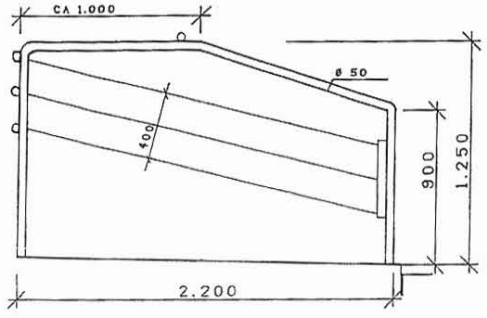
Statistics

A rate (in per cent) of the contamination of each stall, cubicle or feeding cubicle was formed from the average of the daily recordings. The value for each stall or cubicle was grouped into three classes according to the rate of contamination: (a) seldom (less than 25%), (b) intermediate (between 25% and 75%) and (c) very often (above 75%). The results of primiparous cows in cubicles were corrected for stocking density (24 cows in 29 cubicles) by dividing the average value for each cubicle by 0.83 before putting the value into a category. The distribution of the stalls, cubicles and feeding cubicles within these categories was analysed with Fisher's exact test (SAS, 1985).



(a)





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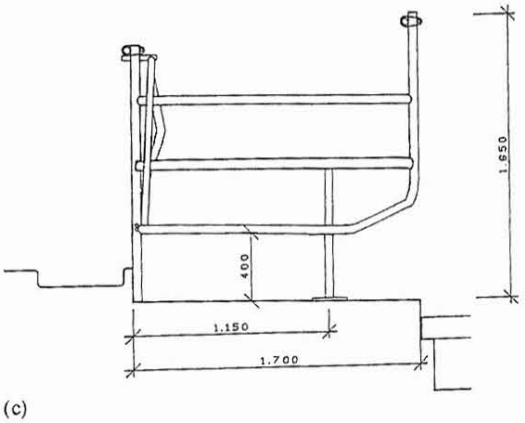

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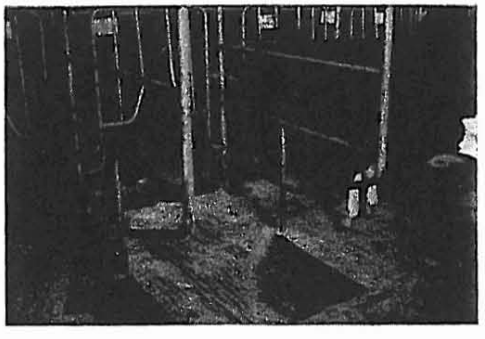

Fig. 1. The design of (a) tie-stalls, (b) cubicles and (c) feeding cubicles.

RESULTS AND DISCUSSION

The tie-stalls were significantly more contaminated than cubicles and feeding-cubicles, for multiparous cows, in the afternoon ($p < 0.05$, Table 2) and the feeding-cubicles were less contaminated than the tie-stalls and cubicles in the morning ($p < 0.01$). Differences between tie-stalls and cubicles, with primiparous cows,

Table 2. *The frequency of contamination of the lying area in the three different housing systems of multiparous cows. Values show the frequency, in per cent, of stalls, cubicles and feeding cubicles, categorized as being contaminated seldom (less than 25% of observations of each stall or cubicle), intermediate (25–75%) and very often (more than 75%)*

Contamination level	% of tie-stalls	% of cubicles	% of feeding-cubicles
n	35	27	16
Morning observation			
Seldom	49	56	100
Intermediate	34	37	0
Very often	17	7	0
Differences*	a	a	c
Afternoon observation			
Seldom	46	78	88
Intermediate	40	22	12
Very often	14	0	0
Differences*	a	b	b

*Different letters within each row differ significantly (a–b = $p < 0.05$; a–c = $p < 0.01$, Fisher's exact test).

Table 3. *The frequency of contamination in tie-stalls and cubicles with primiparous and multiparous cows. Values show the frequency, in per cent, of stalls and cubicles, categorized as being contaminated seldom (less than 25% of observations of each stall or cubicle), intermediate (25–75%) and very often (more than 75%)*

	% of tie-stalls		% of cubicles	
Contamination level	Primi-parous	Multi-parous	Primi-parous	Multi-parous
n	25	35	29	27
Morning observation				
Seldom	8	49	97	56
Intermediate	36	34	3	37
Very often	56	17	0	7
Difference[1]	a		d	
Differences[2]	a	d	a	d
Afternoon observation				
Seldom	20	46	100	78
Intermediate	28	40	0	22
Very often	52	14	0	0
Difference[1]	a		d	
Differences[2]	a	c	a	c

[1]Difference between tie-stalls and cubicles with primiparous cows.
[2]Differences between primiparous and multiparous cows within the same stalls/cubicles.
Different letters, differ significantly (a–c = $p < 0.01$; a–d = $p < 0.001$, Fisher's exact test).

were highly significant ($p < 0.001$, Table 3) for both morning and afternoon registrations. It was also observed, although not objectively registered, that the amount of dung was substantially higher in the contaminated tie-stalls than in the dirty stalls of the other two housing systems.

Parity also had a large influence on faecal contamination of the lying-area. The tie-stalls of the primiparous cows were very often con-

taminated, with more than 50% of the stalls soiled both in the morning and in the afternoon (Table 3). This is probably because these cows were smaller than the older cows, the average weight difference being about 100 kg heavier. The match between cow-size and length of a tie-stall, especially when cow-trainers are not used, is critical for the cleanliness of the tie-stall, and in most barns all stalls are of the same length. This means that smaller cows, like the young ones, will inevitably contaminate their lying area more than larger cows. In the cubicle system, it was observed that the young cows keep their cubicles much cleaner than the older cows. It was evident that the faecal contamination from the older cows emitted from lying cows. This suggested to be caused by the older cows not being as strong and vigorous and thus reluctant to get up as often as primiparous cows *or* that the design of the cubicle is not optimal for lying down and getting up behaviour. Both these causes are reasons for difficulties in lying down and getting up which could result in long lying periods. The use of a brisket board would probably diminish the contamination in the lying area as the cows would more likely lie with their hind part at the edge of the cubicle. Earlier studies by Østergaard (1981) and Østergaard (1985) were unable to find differences between tie-stall and cubicles in dirtiness. However, the stall/cubicle design, the use of cow trainers in tie-stalls and the anthropogenic influence must be considered when determining lying area hygiene. No distinction between young or old cows was made in these studies and recordings were made every other week but not at a fixed time of the day or in relation to barn management.

The very high cleanliness in the feeding-cubicles is contrasted with findings by Østergaard (1981), and needs to be explained. The feeding-regime where roughage is fed in the cubicles, but where all concentrates are supplied in an automatic dispenser in the alley behind the cubicles, encourages the cows to leave the cubicles several times a day to queue for and eat concentrates, but also to search for forage in other feeding-cubicles. This leads to the cow not only leaving her feeding cubicle on her own but will also as a result of being forced out by dominant cows. A considerable part of the dung will therefore be dropped in the alley. In a comparison between different ways of distributing feed (Hansson & Wahlander, 1989) in this same barn, there was a large improvement in cubicle cleanliness when concentrates were given in the dispenser, compared with feeding concentrates at the feeding-table in the cubicles. The fact that the feeding-cubicles were 0.1 m shorter than the tie-stalls must also be considered, but this does not give the entire explanation as stated above. The design of the fronts of the feeding-cubicles were also different, as the present design forces the cow to stand in the middle of the feeding-cubicle, whereas the neck-bar design in the study by Østergaard (1981) allows the cows to stand diagonally.

When comparing tie-stalls, cubicles and feeding-cubicles, it must also be kept in mind that tied cows spend 100% of their time in the stall, but the cubicles are only occupied for about 50% of the time whereas the time the feeding cubicles are occupied is somewhere in between.

Barn hygiene could also be determined by studying the cleanliness of the cows, as suggested by Faye & Barnouin (1985). In the present experiment, cows were recorded for cleanliness on four different occasions during the winter period in a way similar to that used by Faye & Barnouin. However, since the tied cows were regularly groomed, the cleanliness as recorded could not be considered to show a steady state of animal hygiene and therefore it was decided not to include the results here. Additionally, different amounts of bedding were used in the different stall types and this affects the cleanliness of the animal (Nygaard, 1979). The lying area contamination was considered to better reflect the hygienic function of tie-stalls, cubicles and feeding cubicles.

CONCLUSIONS

It was concluded that there are significant differences in faecal contamination of different types of lying places for dairy cows. In this study, tie-stalls were dirtier than both cubicles and feeding cubicles. Young cows contaminated their lying area to a lesser extent than

older cows in the cubicles, while older cows contaminated less than young ones in the tie-stalls.

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