Performance and behaviour at milking after relocation and housing change of dairy cows

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ABSTRACT: The hypothesis that relocation of cows with a housing change temporarily decreases their milk production and affects cows' behaviour in the milking parlour has been proved. Forty-one Holstein cows on the 1^{st} and 2^{nd} lactation were relocated from the tie-stall barn into the free-stall barn. Cows were milked in a 2 × 5 herringbone parlour twice a day. Individual milk yields, order, and used parlour side were recorded electronically during 50 (milk) or 22 (order and side) milking sessions. Milk yield after cows' relocation (23.76 kg) significantly decreased if compared to that reached on the day preceding relocation (30.97 kg; $P < 0.001$). Milk production approached the level of the last day on days 3 and 4 (30.72 and 30.72 kg, respectively) after relocation. Milk yield exceeded that before relocation on day 13 (31.82 kg). There were significant differences between parities during the whole observation period except for the first day after relocation – cows on the 2^{nd} parity yielded more ($P < 0.001$). Multiparous cows entered the parlour earlier than primiparous, equally during morning and evening milkings ($P < 0.01$). Generally a left-side preference was found in the observed cows, while it was more prominent in primiparous than in multiparous cows during evening milkings ($P < 0.05$). Relationships between milking order and milk performance were on days 5–11 negative and significant ($P < 0.01$). We may conclude that although temporarily, relocation with housing and milking changes significantly affected the milk yield.

Keywords: cattle; barn change; milking system; milk yield; behavioural reaction; preference

Dairy cows are often repeatedly moved into new groups during lactation. At each regrouping, cows are mixed with unfamiliar herdmates and must re-establish their social relationships (von Keyserlingk et al., 2011). The change of housing type from tie-stall to loose housing with free-stalls increases the freedom of animals' movement and thereby they get better opportunities to express their natural behaviour (Gupta et al., 2008; Kišac et al., 2011) and their adaptation period to new environment is usually short. However, relocation of lactating dairy cattle into new physical facilities may have worse adverse effects on their behaviour and production traits (Bencsik et al., 2006b; Fregonesi et al., 2007). Dairy cows' comfort is influenced by environmental and management factors like parity, stage of lactation, body weight, and pregnancy (Miciński et al., 2010; Řehák et al., 2012; Zink et al., 2012). When cows are introduced into a new group, their feeding and lying time is reduced, because they are displaced from the feedbunk and freestalls by other cows (Shipka and Arave, 1995; Phillips and Rind, 2001; Brouček et al., 2008).

Decreases in milk yields have also been observed as a result of introducing a cow into a new group.

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According to von Keyserlingk et al. (2008) milk production declined from 43.4 kg to 39.7 kg on the day of regrouping.

Behaviour at milking can be measured as parlour entry order. Milking in unknown parlour can induce a stress reaction (Mačuhová et al., 2008). Wilkes et al. (2005) recorded that older cows were more hesitant to enter the parlour in subsequent periods than the 1st parity cows.

The choice of one side of the milking parlour is routine for many dairy cows. Some cows are very consistent in this choice; they exhibit a clear side preference (Tanner et al., 1994; Hopster et al., 1998). A majority of observed cows (55.7%) choose consistently a specific side in the milking parlour, and the left side was preferred by a majority of these cows (61.5%) (Paranhos da Costa and Broom, 2001).

The aim of this study was to prove the hypothesis that relocation of cows with a housing change decreases their milk production and affects cows' behaviour in the milking parlour. It has also been assumed that the effects of regrouping and habituation on a new type of housing and milking differ according to gestation and parity of cows.

MATERIAL AND METHODS

Forty-one Holstein cows on the 1st and 2nd lactation were relocated from the old into the new barn. Prior to relocation, cows were housed in a barn with tie-stall (1.07 × 2.13 m) and milked twice daily at the stalls. The new barn was a building with group housing. Free-stalls (1.15 × 2.0 m) were bedded with straw. Cows were kept in two pens (movement area 7.4 m^2 per animal, concrete alleys 2.6 m wide). The mean daily air temperature and relative humidity in the housing facility were 14.6°C and 81.3% respectively during the experimental period of 25 days. On the relocation day morning the farm employees took the cows into the new rebuilt facility at the distance of 120 m. The cows were fed a mixed ration consisting of maize silage, lucerne haylage, lucerne hay, barley straw, brewer's grain, sugar-beet pulp, and a concentrate mixture for high-yielding cows. Feed ration was the same from week 1 prior to relocation till week 4 following the moving. Feeding time was set at 9.00 h; feed bunks were located centrally to the free-stall pens and raised 0.68 m above ground. The cows had free 24-h access to feeding except for milking time. Automatic watering troughs were located next to the feed bunks and at the end of free-stall pens.

Data on 41 cows present at 50 milking sessions were subjected to the statistical analysis. In the old barn with tie-stall housing the cows were milked by pipeline milking system with the vacuum level of 50 kPa (standard high-line system), pulsation rate 57 cycles per min, and pulsation ratio 60 : 40. The last two individual milk yields were recorded during the evening and morning milking (day 0). The first milking after relocation took place the same day in the evening and the second one the next morning (day 1). Cows were milked in a 2 × 5 herringbone parlour with the vacuum level of 50 kPa, pulsation rate 55 cycles per min, and pulsation ratio 60 : 40. The parameters of the both milking systems were similar. The milkings took place twice a day (at 6.00 and 17.00 h), after the cows being driven by the herdsman for a short distance within the barn to a waiting area closer to the milking parlour. The time spent by each cow in the waiting area before milking varied from 15 to 40 min. Cows entered the parlour individually once a milking stall was available. After exit from the parlour, cows remained in a separate holding pen until all other cows in the group were milked and then returned to their pen.

Individual milk yields, order, and used parlour side were recorded electronically at each milking. We recorded the order (1–5 on each side of parlour) and side chosen by each cow (left or right, 1 or 2) during 22 milking sessions. Means of side choices were calculated from sums for 11 sessions of morning and 11 sessions of evening milkings. Means from 11.00 to 16.99 were designated as left side preference and means from 17.00 to 22.99 as right side preference.

The data were subjected to Analysis of Variance (ANOVA) using the GLM Procedure of SAS (Statistical Analysis System, Version 9.0, 2008). Factors of day, gestation (pregnant, not pregnant), and parity (1st, 2nd) were evaluated. The dependent variables included all measures of milk yield, order at milking (1–5), and side at milking (left, right). The normality of data distribution was evaluated by the Wilk-Shapiro/Rankin Plot procedure. Significant differences between groups were tested by Comparisons of Mean Ranks. Values were expressed as means ± SD.

The comparisons between left and right side were calculated by the paired *t*-test. The correlations between entrance order at milking and observed factors (gestation, parity, side) and between entrance order at milking and milk yield on observed days were calculated using the Spearman's rank correlation coefficient.

RESULTS

The last day before relocation the observed cows produced 30.97 ± 7.26 kg milk (Table 1). On day 1 after moving the milk production significantly lowered (23.76 kg, $P < 0.001$). Milk yield got closer to that of the last day on days 3 and 4 following the relocation (30.72 ± 8.70 and 30.72 ± 9.47 kg, respectively). Milk yield reached and even exceeded the authentic basal levels as late as on day 13 (31.82 ± 8.97 kg). Similar trend was recorded in both evaluated factors (gestation, parity).

Higher yields (insignificantly) were recorded in non-pregnant than in pregnant cows, significant

Table 1. Milk yield before and after relocation according to gestation and parity (mean ± SD)

Day	Milk yield (kg)		Gestation				Parity				Significance parity
			1		2		1		2		
0	30.97	7.26	29.45	7.10	32.56	7.26	25.42	4.16	35.31	6.14	0.0000***
1	23.76	7.21	23.07	5.36	24.48^{a}	8.83	21.16	4.73	25.80^{a,c}	8.20	ns
2	27.53	8.09	27.85	6.15	27.20	9.89	24.65	5.45	29.79	9.16	0.0234*
3	30.72	8.70	30.28	7.60	31.20	9.91	26.92^{a}	5.97	33.70	9.43	0.0109*
4	30.72	9.47	29.47	8.51	32.05	10.44	25.22	5.65	35.04^{b}	9.69	0.0011**
5	28.20	7.49	26.63	6.44	29.84	8.30	23.71	5.35	31.71	7.10	0.0005***
6	27.91	8.21	27.61	6.49	28.22	9.87	23.61	5.56	31.27	8.48	0.0017**
7	27.12	8.21	24.12	4.97	30.26	9.77	21.16	5.66	31.78	6.77	0.0000***
8	28.74	8.89	27.15	7.57	30.41	10.02	23.04	6.79	33.20	7.80	0.0002***
9	27.01	8.68	26.17	8.13	27.90	9.35	20.74	4.35	31.92	8.06	0.0000***
10	25.75	8.47	25.77	8.58	25.72	8.56	20.19^{b}	4.89	30.09	8.18	0.0000***
11	28.18	9.25	25.94	10.24	30.53	7.63	22.02	6.06	33.00	8.48	0.0002***
12	28.89	9.70	25.86	8.96	32.06	9.65	22.46	5.10	33.92	9.53	0.0003***
13	31.82	8.97	29.22	8.31	34.54	9.02	25.52	5.42	36.75^{d}	8.09	0.0001***
14	32.16	8.87	28.88	7.83	35.60^{b}	8.77	26.44	6.71	36.63^{d}	7.79	0.0005***
15	26.86	8.51	25.81	7.70	27.97	9.37	22.93	6.35	29.94	8.84	0.0129*
16	26.97	7.64	25.50	6.93	28.51	8.22	22.36	4.66	30.57	7.65	0.0008***
17	27.99	8.38	27.69	8.06	28.31	8.90	23.93	7.19	31.17	7.99	0.0041**
18	29.26	8.59	27.91	7.67	30.67	9.46	23.97	4.77	33.39	8.71	0.0004***
19	27.95	8.38	26.07	7.89	29.92	8.63	22.80	4.11	31.98	8.72	0.0007***
20	26.14	8.96	24.46	8.00	27.91	9.76	20.40	4.06	30.64	9.23	0.0003***
21	26.17	7.53	24.55	6.96	27.86	7.90	22.33	4.41	29.17	8.16	0.0091**
22	26.43	7.30	24.57	7.46	28.37	6.78	22.57	5.02	29.44	7.48	0.0075**
23	26.09	7.45	23.57	6.94	28.73	7.19	21.17	3.77	29.93	7.40	0.0004***
24	28.56	9.49	26.40	8.41	30.84	10.23	24.03	5.71	32.12	10.42	0.0172*

SD = standard deviation, ns = nonsignificant, 0 = last day before relocation, 1 = first day after relocation

parity: 1 (n = 18), 2 (n = 23); gestation: 1 = pregnant (n = 21), 2 = nonpregnant (n = 20); significance within factors: 1st parity D3:D10*, 2nd parity D1:D13,14**, D1:D4*; nonpregnant D1:D14*

*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$

means with different superscripts differ at ^{a,b}($P < 0.05$), ^{c,d}($P < 0.01$)

interactions: day 7: gestation × parity ($P < 0.01$)

Table 2. Milking order and choice of parlour side according to gestation and parity

Variable	n	$\bar{x}$	SD	Gestation		Parity		Significance parity
				1	2	1	2	
Order AM	41	2.99	1.43	3.14 ± 1.41	2.84 ± 1.44	3.24 ± 1.45	2.80 ± 1.39	0.0059**
Order PM	41	3.03	1.44	3.14 ± 1.44	2.91 ± 1.42	3.30 ± 1.37	2.81 ± 1.46	0.0011**
Order total	41	3.01	0.66	3.14 ± 0.43	2.87 ± 0.40	3.27 ± 0.31	2.81 ± 0.41	0.0012**

SD = standard deviation, AM = morning, PM = evening
parity: 1 (n = 18), 2 (n = 23); gestation: 1 = pregnant (n = 21), 2 = nonpregnant (n = 20)
**$P < 0.01$

difference between day 1 and day 14 was found in non-pregnant cows only (24.48 ± 8.83 kg compared to 35.60 ± 8.77 kg; $P < 0.05$) (Table 1). For the whole observed period after relocation but for day 1 significant differences between parities have been registered – cows on the 2nd parity yielded more.

Small differences appeared between morning and evening milkings as concerns the milking order (Table 2). Pregnant cows had insignificantly higher mean of the milking order, they entered the milking parlour as the last. There were found significant differences in behaviour at milking variables between parities. Multiparous cows entered the parlour earlier than primiparous cows, equally during the morning and evening milking (2.80 ± 1.39 vs. 3.24 ± 1.45, $P < 0.01$; 2.81 ± 1.46 vs. 3.30 ± 1.37, $P < 0.01$). Similarly, lower mean of total orders was recorded in multiparous cows, too ($P < 0.01$).

In the present study a left-side preference of the observed cows was found (Table 3). Two subgroups of cows differed in the side preference between morning and evening milking, pregnant cows (17.00 ± 1.34 vs. 16.14 ± 1.62, $P < 0.05$) and 1st parity cows (16.89 ± 1.49 vs. 15.67 ± 1.37, $P < 0.01$). During evening milkings primiparous cows showed a more prominent left-side preference than multiparous cows (15.67 ± 1.37 vs. 16.78 ± 1.67, $P < 0.05$) (Table 3). From the evaluation of all the 22 milking sessions it followed that the animals preferred mostly left side, 18 cows (43.9%) in the

Table 3. Effect of milking time on side choice in parlour

Variable	n	Mean	SD	Min	Max	Significance
Side AM	41	16.76	1.37	14.00	19.00	0.0894
Side PM	41	16.29	1.63	14.00	20.00	
Pregnant						
Side AM	21	17.00	1.34	15.00	19.00	0.0121*
Side PM	21	16.14	1.62	14.00	19.00	
Nonpregnant						
Side AM	20	16.50	1.39	14.00	19.00	0.9078
Side PM	20	16.45	1.67	14.00	20.00	
First parity						
Side AM	18	16.88	1.49	15.00	19.00	0.0033**
Side PM	18	15.67^a	1.37	14.00	18.00	
Second parity						
Side AM	23	16.65	1.30	14.00	18.00	0.7052
Side PM	23	16.78^b	1.67	14.00	20.00	

SD = standard deviation, Min = minimum, Max = maximum, AM = morning milking, PM = evening milking
means with different superscripts differ at ^{a,b}($P < 0.05$)
*$P < 0.05$, **$P < 0.01$

Table 4. Relationships between order at milking and observed factors

Milking time	Gestation	Parity	Side total
AM	–0.271	–0.431**	0.459**
PM	–0.215	–0.442**	0.738***
Total	–0.356*	–0.558***	0.747***

AM = morning milking, PM = evening milking

*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$

Table 5. Relationships between order at milking and milk yield

Day	Order total	Day	Order total	Day	Order total
1	–0.214	5	–0.444**	9	–0.424**
2	–0.173	6	–0.379*	10	–0.322*
3	–0.138	7	–0.592***	11	–0.499**
4	–0.249	8	–0.364*		

*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$

morning and 21 cows (51.2%) in the evening. But no one cow visited exclusively one side.

Relationships between milking order during morning and evening and parity were negative and significant (–0.431**, –0.442**, –0.558***). Correlations between milking order and side choice were positive and significant (0.459**, 0.738***, 0.747***) (Table 4). All relationships between milking order and milk performance were negative during the whole experimental period (on days 5–11 significantly) (Table 5).

DISCUSSION

The present study revealed that relocation to an unknown building with novel housing type had a negative impact on dairy cows. The farm animals' coping with environment changes is definitely reflected in their neurological and endocrine functions (Friend, 1989; Albright and Arave, 1997; Miciński et al., 2010). Of course it depends on their health and body condition (Jílek et al., 2008; Maršálek et al., 2008; Tongel and Brouček, 2010).

The milk yield after cows' relocation (23.76 kg) dropped significantly compared with that on the last day before relocation (30.97 kg). First lactation cows (83.2%) had lower declines in milk yield than older cows (73.1%) (4.26 vs. 9.51 kg). However, milk yield after relocation approached the level of the last day in 3–4 days. Relocation caused a prolonged stress, but cows quickly adapted to the new facility. The decrease in mean milk associated with relocation did not last long in this study. On day 13 the milk yield exceeded the value before relocation. This can be explained by better conditions in the new barn and better well-being in free-stall housing. The replacement of tie-stall barns by free-stall housings brings a great change in the life style of the dairy cow.

Results of this study agree with reported decrease in milk production associated with animals' moving. Hill at al. (2005), von Keyserlingk et al. (2008), and Krawczel et al. (2008) showed that regrouping can disrupt milk production for hours to days and pointed out the need of future research to identify management changes leading to reduction of these effects. Other authors (Schirmann et al., 2011) indicated that regrouping cows into small groups (which was the case of the present study) can minimize these effects. Every regrouping leads to a cow's exposure to new animals or their combinations (Gupta et al., 2005; Bencsik et al., 2006a; Čuboň et al., 2008; Frelich et al., 2009). Significant interference to cow's well-being in our case was the manner of milking and parlour change. Especially when you consider that this was a change from pipeline milking system in tie-stall housing to milking in the milking parlour.

In the present study, multiparous cows entered the parlour earlier than the primiparous, equally during morning and evening milkings. Also other studies showed that the primiparous cows, kept in the group of multiparous cows, entered the milking parlour as the last (Hopster et al., 1998). Although entry order may be affected by social dominance (Albright and Arave, 1997; Hillerton et al., 2002) or novelty feed in the parlour (Ceballos and Weary, 2002), it may be also determined by stress from entering the milking parlour (Wilkes et al., 2008). Older cows were more experienced in coping with the unknown space. The adaptation to the parlour was unexpectedly fast. This testifies to the increasing relevance of correlation tests. One of the reasons highlighted by Herskin et al. (2004), Grasso et al. (2007), and Mačuhová et al. (2008) could be a good relationship between the milkers and the cows. A problem may consist in negative past experiences, some cows entered the milking parlour reluctantly. However, little is known about the stability of the milking parlour entry order of primiparous and multiparous dairy cows when kept in common groups.

In the present study, the relationships between milking order and milk performance on days 5–11 were negative and significant. It is a sign of stabilization of the cows' social order and improving well-being.

Left-side preference was found in the observed cows. Primiparous cows clearly prefered left side than multiparous cows during evening milkings. There was an evident individual variability in results.

Differences were also found between morning and evening milking sessions, similarly as recorded by Paranhos da Costa and Broom (2001). In other works it has been demonstrated that some cows were very stable in the choice of one side of the milking parlour, showing a clear preference (Tanner et al., 1994; Grasso et al., 2007) for one out of the two sides. In the present study 44% cows during morning milkings and 51% cows during evening milkings chose mostly left side. According to Hopster et al. (1998) this behaviour persists all the time despite group changes, lactation stage, and season. Side preference in dairy cows is a stable individual trait and large inter-individual differences can be found.

Probably, as noted by Grasso et al. (2007), also the parlour design can affect a cow's side choice. It our case, the left side was closer to the entrance to the milking parlour. The asymmetry of the milking parlour may have induced the tendency of the majority of the cows to go to one side rather than to the other. Another possibility is that some cows have a side preference due to a natural laterality or neurological development as presented by Tanner et al. (1994) and Albright and Arave (1997). We may also speculate on that the higher the milk production the lower the order. However, it is almost certain that the animals' behaviour can be afftected by a large variety of aspects and unexpected situations.

CONCLUSION

In our experiment, relocation to a new facility had a negative impact on cows' milk yield. Cows altered their behaviour and physiological stress indicators were elevated on the day of relocation. Side preference seems to be a stable characteristic of an individual dairy cow. Our results support this statement. The reactions toward the changeover from pipeline to parlour milking varied widely within cows. More research should be done examining the effects of relocation at varying stages of lactation and gestation and group sizes.

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