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Effect of management change on selected welfare parameters of cows*

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The aim of the study was to determine the effect of relocation from a tie-stall barn to the facility with free-stall housing on adaptation of cows measured by behaviours latency and lenghts of the first episodes. Cows were observed at 10-min intervals for 48 hours after relocation on the first and second days. Second parity cows and non-pregnant cows lied down sooner than those in the first lactation and pregnant cows (532.2±274.6 min *vs*. 678.3±278.9 min; 588.5±237.0 min *vs*. 603.8±326.1 min). Primiparous and pregnant cows had shorter lying episodes following the relocation (25.0±12.9 min. *vs*. 51.4±31.8 min, P<0.001; 38.3±24.8 min *vs*. 46.0±35.8 min). Latencies for total lying (first time lying down regardless of which side cow lays) and lying on the left side were progressively shorter from the first milking session to the fourth milking session. Cows in second lactation and non-pregnant cows began ruminating sooner than cows in first lactation after the first and fourth milking sessions. The results of this study suggest that relocation may alter behavioural measures. However, behaviour after milking sessions observation indicate that older and non-pregnant cows are more able to adapt quickly to environmental change.

KEY WORDS: dairy cow / housing / relocation / welfare

Dairy cow's well-being can be influenced after barn and housing change by endogenous and exogenous factors. Endogenous factors include genetic or physiological

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conditions (breed, age, lactation parity, gestation stage, and temperament) [Gupta *et al*. 2008, Macuhova *et al.* 2008]. Exogenous factors include physical environment (season, climate, weather, photoperiod) and social environment (stocking rate, space, group structure, sex ratio) – [Soch 2005, Bencsik *et al.* 2006a, Wilkes *et al.* 2008, Broucek *et al.* 2011]. After relocation animals must cope with new conditions.

Regrouping is a required management intervention, but it aggravates social behaviour, prolongs the duration of standing and increases the frequency of lying bouts [Hasegawa *et al.* 1997]. Cows need to have opportunity to lie down to allow optimum rumination conditions and increased well-being. Lying activity has a high priority and with time constraints cows allocate more time to lying than to feeding [Munksgaard *et al.* 2005, Broucek *et al.* 2008]. Lying without ruminating occurs usually earlier than with ruminating during a lying bout [Norring *et al.* 2008].

Cows tend to spend less time lying down after regrouping, likely because those entering a new group are often displaced from lying area by other cows [von Keyserlingk *et al.* 2008]. According to Schirmann *et al.* [2012], regrouping can affect dairy cows, especially those that are moved to an unknown pen. Both primiparous and multiparous cows spent more time standing in the mixed group. Daily lying time increases with increasing age and parity [Chaplin and Munksgaard 2001]. Multiparous cows ruminate more while lying than do heifers [Norring *et al.* 2012].

Munksgaard *et al.* [2005] suggest that cows are motivated to maintain their lying time even if it results in decreased time spent on other behaviour. Yet stall design affects how a cow behaves when changing from the standing to lying position [Ceballos *et al.* 2004].

Cattle exhibit behavioral laterality [Phillips *et al.* 2003]. Arave and Walters [1980] found lower lying preferences on the left side in older cattle. Cows in late pregnancy show left side laterality, probably because the foetus is positioned towards the right side of the body. Albright and Arave [1997] observed that rumination was more common when cows were recumbent on the left body side rather than on the right side and conclude that left side laterality facilitates rumination. This factor may increase left side laterality in young cows during late stage of pregnancy [Phillips *et al.* 2003].

The aim of this study was to assess the effect of relocation to a new facility on adaptation of cows measured by behaviour latency and number of episodes. Our hypotheses were that parity and gestation would alter the resting and feeding behaviour of lactating dairy cows following relocation.

Material and methods

Prior to relocation, 41 Holstein cows in their first and second lactation were housed in a tie-stall barn bedded with straw. Two cows had always access to one water bowl and all of them were milked twice daily by pipeline milking system. On the morning of relocation day, farm workers led cows to the new facility with group housing from 9.30 to 10.00 a.m. Cows were kept in two pens (movement area 7.4 m^2 per animal,

concrete alleys 2.6 m wide). Grouping was balanced neither for stage of lactation nor for parity. Free-stalls (1.15 x 2.0 m) were bedded with straw. Cows were milked twice daily after being driven to a waiting area adjacent to the herring bone milking parlour (2 x 5). The first milking after relocation was between 6.00 and 7.30 p.m. and second one the next morning between 7.30 and 9.00 a.m. The free-stall barn was illuminated throughout the experiment (day hours minimum 160 Lux, night hours 50 Lux). Ambient temperature and relative humidity were monitored continuously using data loggers. The average daily air temperature and relative humidity in the housing facility were 14.5±1.49° C and 79.6±3.17%, respectively, during the whole period.

Following relocation, all cows had daily feed prepared in throughs. Subsequently, they were fed once daily at 10.00 a.m. All cows were fed with total mixed ration (TMR) throughout the study. Diet composition (DM %) was maize silage (35.00), lucerne haylage (32.20), lucerne hay (16.80), barley straw (2.00), brewer's grain (2.00), sugar-beet pulp (3.00), and concentrate mixture for high-yielding cows (9.00). Access to feed was allowed throughout the 24-h period, except during milking. Water bowls were fixed next to free-stall pens.

Cows were observed over 48 hours after moving into the new free-stall housing (from 10.00 a.m.) on the first and second day. Behavioral observations were recorded at 10 min intervals. Cows were monitored for time spent lying, standing (including time spent in milking parlour), feeding, ruminating (ruminating while standing, and ruminating while lying). Based on gathered data, activity latencies and epizodes were determined. The latency for each cow to the initiation of defined behaviour after relocation was determined. Latency time for total lying is first time lying down, regardless on which side cow lays. Latency for lying on the left side was calculated as first time lying down on the left side.

Episodes were summed as continuous series of records of the same activity lengths after relocation and four milkings (first and second milking session during 24 hours, third and fourth during 25-48 hours).

The data were analysed using a General Linear Model ANOVA as repeated measures by the statistical package STATISTIX, Version 9.0. Factors were: day (first, second, tenth), order of milkings (1 to 5), parity (first, second), and gestation (pregnant, not pregnant). The normality of data distribution was evaluated by the Wilk-Shapiro/Rankin Plot procedure. All data conformed to a normal distribution. Significant differences between groups were tested by Comparisons of Mean Ranks. Values are expressed as means±SD. All data showed a normal distribution. Significace of differences between groups were tested by Comparisons of Mean Ranks. Values are expressed as means±SD.

Results and discussion

Behaviour after relocation

Behavioural latencies were not significantly different among treatment groups following relocation. Neither parity nor gestation affected latency to lie down, ruminating or feeding. The cows in their second parity and non-pregnant cows lied down earlier after relocation than cows in their first lactation and pregnant cows. Significant difference trends between first and second parity were recorded in the times of the first total lying on both sides (678.3±278.9 min *vs*. 532.2±274.6 min), lying on the left side (793.3±453.2 min *vs*. 648.7±382.2 min), and lying on the right side (1053.3±663.7 min *vs*. 745.0±380.0 min). Times lying tended to vary between groups of pregnant and non-pregnant cows in the first total lying (603.8±326.1 min *vs*. 588.5±237.0 min), lying on the left side (760.5±504.9 min *vs*. 661.5±300.5 min), and lying on the right side (980.0±654.8 min *vs*. 777.4±371.0 min).

Following the relocation, primiparous cows had shorter lying episodes (25.0±12.9 min *vs*. 51.4±31.8 min; $P<0.001$), the time of lying on the left side (40.0±29.4 min *vs*. 58.6±33.9 min; $P<0.05$), and lying time on the right body side (15.0±7.1 min *vs*. 52.5±5.0 min; $P<0.001$) than older cows. Significant differences were also observed in gestation effects. Pregnant cows exhibited shorter times of first lying episodes in the total lying time (38.3±24.8 min *vs*. 46.0±35.8 min; $P<0.05$), longer times of the first lying episode on the left side (53.3±30.8 min *vs*. 50.0±37.4 min.; $P<0.01$), and a longer duration of ruminating (18.5±14.2 min *vs*. 15.5±9.4 min; $P<0.05$) than non-pregnant cows following the relocation.

Cows of second parity and non-pregnant cows lied down sooner than did cows in first lactation or pregnant cows. It could be due to multiple reasons. Second lactation cows needed less time to lie down due to a faster adaptation phase. However, Krohn and Munksgaard [1993] observed that in older cows it took longer to lie down than in primiparous cows, apparently because higher parity cows spend longer time examining the bed before lying down. Primiparous cows have been reported to spend less time lying and feeding, have lower dry mater intake, and were involved in negative aggressive interactions when mixed with multiparous cows [Soch *et al.* 1997, Phillips and Rind 2001, Huzzey *et al.* 2012]. Relocation and mixing of unfamiliar cows resulted in modification of behaviour immediately following the change. The lying time was reduced; an increase in time spent walking was evident. However, these modifications were clearly evident only during first day after moving and change of housing type.

The decreased lying time on the day of relocation may have been due to some cows being much less willing to displace others to gain access to a preferred free-stall [von Keyserlingk *et al.* 2008].

Cows occasionally manifested a reduced latency to first lying down. Chaplin *et al.* [2000 a] reported about significant findings when cows showed more frequent lying after deprivation of lying. Lying deprivation can cause a rest disturbing. Krohn and Munksgaard [1993] and Bolinger *et al.* [1997] wrote that cows changed their lying

position depending on whether or not they were restricted from lying down before. Laterality is not random, but is motivated by the amount of rumen fill, slope of the floor, stage of gestation and occupancy of an adjacent stall.

Post-milking behaviour

The total lying time is not the most sensitive measure of disruption to lying behaviour. Explicit opinion of lying behaviour must include other activities, especially latency times. It is certainly very important for the evaluation to know what time of interruption cow needs to calm down. Latencies of total lying (first time lying down regardless of which side cow lays) and lying on the left side were progressively shorter from the first milking session until the fourth milking session (174.9±154.9 mi. *vs*. 85.8±65.3, P<0.001; 222.2±148.3 min *vs*. 126.1±91.3, P<0.01) (Tab. 1).

In this study the second-lactation and non-pregnant cows began tp ruminate sooner than cows in the first lactation after first and fourth milkings.

In addition, parity and gestation indicated no effect on the lying on the right side and feeding latency after milkings. Latency times of lying (the first lie down) were always shorter in the left side than in the right body side lying (Tab. 1). Significant differences were recorded between parities in the total lying and lying on the left side (P<0.001, P<0.01), respectively. Noticeable differences occurred after first and third milking sessions (236.7±179.6 min *vs*. 126.5±114.6 min, P<0.05; 170.6±50.3 min *vs*. 95.6±45.7 min, P<0.01; 272.8±133.4 min *vs*. 144.8±97.8 min, P<0.01). Latencies of ruminating differ among both treatments (P<0.05). Cows in the second lactation began ruminating sooner than those in the first lactation after first and fourth milkings (58.7±38.4 min *vs*. 86.1±40.6 min; 82.2±52.9 min *vs*. 107.8±55.8 min; P<0.05). Non-pregnant cows started to ruminate sooner than pregnant cows after the fourth milking session (82.5±55.8 min *vs*. 110.0±52.8 min; P<0.05) (Tab. 1).

Lenghts of the first behaviour`s episode did not vary significantly by parity or gestation among the groups. Significant differences were recorded only in the milking sessions order. First lying episodes after returning from the milking parlour were the longest after the third milking session in all resting activities (total lying, lying on the left or right side). Similarly, lenghts of rumination and feeding episodes became gradually longer starting with the first measurement (18.8±14.0 min; 26.3±18.4), reaching the greatest length after the third or fourth milking session (23.2±19.0 min, P<0.05; 37.5±31.8 min, P<0.05).

In the present study, cows were not put into groups to acclimate them to a new social structure before relocation. Regrouping of dairy cows could cause an increase in nervousness and aggressive behaviour leading to worsen welfare. High stocking densities after supplying food increase competition and keep sub-ordinate cows away from feed. A reduction in the time cows spend resting can lead to physiological changes associated with stress.

Generally, cows lay down sooner after morning milkings rather than after evening milkings (first and third session) (Tab. 1). However, according to Boyle *et al.* [2011]

it is more beneficial to introduce heifers into the main dairy herd after evening milking, because there was a decreasing level of aggression to which cows were exposed. Most treatments are not implemented in practice until after relocation.

Hirst *et al.* [2002] discussed that housing conditions such as space allotment, confinement or restraint in stalls have little effect on total amount of time cattle spent in recumbent rest. The reduction in feeding time after milking and decreased latency to lay down resulted in a tendency for less aggressive interactions at the feed alley after the cows returned from milking [Micinski *et al.* 2010, Tongel and Broucek 2010].

In the present study we noticed disruptive effects on behaviour and stress associated with relocation to the new facility. All changes were most noticeable during the 1st day of relocation to the new facility. Some management factors affect lying behaviour regardless of system, such as milking frequency, microclimate conditions, and the transition from milking parlour to housing section [Bencsik *et al.* 2006b, Herbut *et al.* 2012]. However, many management factors affecting lying behaviour are specific to the system in which the cow is housed. The behaviour of loose-housed dairy cows is affected by milking and feeding time. The cows activities also depend on their lactation stage. Space allowance, free-stall design, and bedding would be considered [Chaplin *et al.* 2000b, Cubon *et al.* 2008, Mihina *et al.* 2012].

Table 1. Behavioural latency (min) after milkings according to parity and gestation for each of four milkings after relocation (means±SD)

Activity	N	Milking 1	N	Milking 2	N	Milking 3	N	Milking 4	Parity	Gest
Total lying	41	174.9±154.9	40	114.7±60.7	41	128.5±60.3	41	85.8±65.3	0.0004***	NS
1st lactation	18	236.7^{a}±179.6	17	127.6±58.4	18	170.6^{a}±50.3	18	101.1±82.8		
2nd lactation	23	126.5^{b}±114.6	23	105.2±61.8	23	95.6^{c}±45.7	23	73.9±46.1		
Pregnant	21	210.0±196.4	20	120.5±62.6	21	149.5±62.4	21	101.9±78.6		
Non pregnant	20	138.0±84.3	20	109.0±59.7	20	106.5±50.7	20	69.0±43.6		
Left side	36	222.2±148.3	36	153.6±95.9	41	200.9±130.2	39	126.1±91.3	0.0090**	NS
1st lactation	15	253.3±148.8	14	150.7±73.1	18	272.8^{a}±133.4	16	154.4±121.0		
2nd lactation	21	200.0±147.5	22	155.4±109.7	23	144.8^{c}±97.8	23	106.5±58.6		
Pregnant	17	265.3±169.5	17	160.0±116.6	21	236.2±146.9	19	143.7±101.6		
Non pregnant	19	183.7±117.9	19	147.9±75.8	20	164.0±100.8	20	109.5±79.3		
Ruminating	41	70.7±41.2	41	98.0±69.2	41	81.5±51.1	41	96.6±55.4	0.0486*	0.0410*
1st lactation	18	86.1^{a}±40.6	18	103.9±81.1	18	96.7±64.1	18	107.8^{a}±55.8		
2nd lactation	23	58.7^{b}±38.4	23	93.5±59.9	23	69.5±35.3	23	82.2^{b}±52.9		
Pregnant	21	74.3±44.0	21	96.2±52.0	21	99.0±50.8	21	110.0^{a}±52.8		
Non pregnant	20	67.0±38.9	20	100.0±85.1	20	63.0±45.8	20	82.5^{b}±55.8		

*P<0.05; **P<0.01; ***P<0.001.
Different superscript letters within each activity column are significantly different: a-b – P<0.05; a-c – P<0.01.

However, many management factors affecting lying behaviour are specific to the system in which the cow is housed. The behaviour of loose-housed dairy cows is affected by milking and feeding time. The cows activities also depend on their lactation stage. Space allowance, free-stall design, and bedding would be considered [Chaplin *et al.* 2000b, Cubon *et al.* 2008, Mihina *et al.* 2012].

Study by Keyserlingk von *et al.* [2008] shows that regrouping can disrupt behaviour and production in the hours and days following regrouping and suggests the need for future research to identify management changes that reduce these effects. Each

regrouping exposes the cow to new individuals or new combinations of individuals [Cook *et al.* 2004, Krawczel *et al.* 2012]. After regrouping, dairy cows must establish their position in the hierarchy of the new group. It can be assumed that regrouping is likely a stressful event. Reduced access to feeding or laying beds, because of increased stocking density, may have a detrimental effect on the behaviour of the lactating dairy cow. Before relocation observed cows were kept in the same tie-stall barn without daily exercise.

Study by Chaplin *et al.* [2000b] demonstrated that relocation (transfer to a new facility) and housing change may cause a disruption in lying behaviour of cows adapted to housing after more days. In conclusion, there were noticeable effects on cows associated with removing to the new facility. The reactions towards the changeover to housing system varied widely within cows. However, changes after milking session's observation indicate that cows are able to adapt quickly to environmental change. Older and non-pregnant cows were more adaptable to management change.

This study shows that relocation can disrupt behaviour in the hours and days following regrouping and suggests the need for future research to identify management changes that reduce these effects. Further research needs to be done to understand the relationships among behavioural changes and other treatment factors.

Our results indicate that farmers may be able to alleviate the negative effects of regrouping on behaviour and welfare of dairy cows. Relocation of dairy cattle to a new facility and housing type offers many benefits. But, there is the potential for adverse effects.

This research will serve as a base for future studies and empirical findings reported to provide a new understanding of management methods. This information can be used to develop targeted interventions aimed at improving of dairy farming.

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