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EFFECTS OF STAGE OF PREGNANCY AND LACTATION ON MAINTENANCE BEHAVIOUR OF DAIRY COWS AFTER HOUSING CHANGE

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ABSTRACT

The aim of this study was to investigate the effects of time in days, pregnancy and lactation stage on behaviour of cows after change in type of housing. Forty eight hours long observation of 40 Holstein cows was done. The activities were registered at intervals of 10 minutes. The duration of total lying and ruminating increased (336.3 min. vs. 628.0 min., 318.0 min. vs. 325.4 min., P<0.001), the total time of standing decreased from the first day to the second day (1103.6 min. vs. 812.1 min., P<0.001). Number of periods of total lying, lying on the left and right side, and total ruminating also increased (P<0.001). The opposite course was recorded in the parameters of eating and total standing (P<0.001). No significant difference was noted in the stage of pregnancy factor, neither in duration of behaviour nor in number of periods. The longest total time of lying was observed in animals which were in lactation stage from 101st to 200th day (stage 2) (P<0.01). The longest times of eating and total standing were found in cows from the 1st to 100th day, and the shortest in cows classed in the stage 2. The highest number of periods of total lying (P<0.001), lying on the left and right sides were registered in cows which occurred in stage 2 (P<0.01).

Key words: dairy cow; behaviour; pregnancy and lactation stage; housing

INTRODUCTION

The comfort of dairy cows could improve while moving animals from tie-stall to loose-housing, especially free-stall systems. In a tie-stall the cows are tied to their neck and they cannot walk around freely. It is generally known that free-stall housing is superior to tie-stall housing. Advantages include decreased bedding use and decreased labour for maintenance. Compared to tie-stall systems, free-stalls provide a more natural, less restrained environment for cows, allowing them to feed and exercise at will. Physical barrier between cows, including head lockers can help reduce this feed competition and increase feeding time (Cook, 2003; Keyserlingk von, Weary, 2009).

Management practices put great effort on a cow's daily time budget for lying, feeding, and drinking. However, relocation of animals with contemporary regrouping is usual husbandry practice. Social stress allied with increased aggressiveness, locomotion, and nervousness owing to the presence of unfamiliar environment occurred following grouping of familiar and unfamiliar animals (Bøe *et al.*, 2006; Hvozdík *et al*., 2003; Kottferová *et al*., 2008). Cows are deprived of lying for longer periods and abnormal behaviour patterns or frustration can be indicative (Munksgaard and Simonsen 1996). According to some authors (Haley *et al*., 2000; Brouček *et al.*, 2008), reducing the time that dairy cows can lie down has adverse effects on their welfare. After housing change cows could have more interrupted attempts at lying and explore the lying area more prior to lying down.

Cattle comfort is usually influenced by a number of animals, environmental and management factors such as parity, stage of lactation and pregnancy which can ultimately shorten daily lying times or increase number of periods (Cook, 2003; Debrecéni *et al*., 2009; Brouček *et al*., 2011).

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This study was conducted to determine whether factors of day, pregnancy and lactation stages have effect on behaviour after relocation to a new barn.

MATERIAL AND METHODS

Forty Holstein cows at the age and live body weights of 1243.5 ± 112.66 days and 557.66 ± 44.90 kg, respectively were used. The average lactation and pregnancy stages were 202.56 ± 134.65 and 52.02 ± 75.22 days, respectively.

Before relocation, cows were housed in a tie-stall housing of the old facility. On the morning of relocation day, farm employees led cows to the new; rebuild facility, at a distance of 120 m. The rebuilt facility was free-stall housing with concrete alleys (2.6 m). Stalls (1.15 x 2.0 m) were bedded with straw mattresses above the concrete floor covered lightly with sawdust. Cows were kept in two pens (movement area 7.4 m^2 per animal).

The mean daily air temperature and relative humidity in the housing facility were continuously recorded using data loggers. The mean daily air temperature and relative humidity in the housing facility were 14.9 ºC and 80.9 %, and 15.2 ºC and 87.9 % during the experimental period of two 24 hours observations respectively.

The cows were fed a mixed ration consisting of maize silage, lucerne haylage, lucerne hay, barley straw, brewer's grain, sugar-beet pulp, and concentrate mixture for high-yielding cows. The total mixed diet was administered to troughs in the production barn by a feeding wagon once a day during milking. Feeding was allowed throughout the 24-h period, except during milking. These cows were driven up to a milking parlour when milked.

Cows were observed during two consecutive days (48 hours) after moving into the rebuilt barn with free-stall housing. In the behavioural activity category, they were observed at intervals of 10 minutes for the following: total lying down (laterality and semi-laterality on the left and right side); eating; total ruminating (ruminating while standing plus ruminating while lying); total standing (with or without movement, including time spent in milking parlour).

The data were analyzed using a General Linear Model ANOVA by the statistical package STATISTIX, Version 9.0. There were evaluated factors of day (first, second), stage of pregnancy (1 - non pregnant, 2 - pregnant from the 21st day to five months, 3 - from five to nine months), and lactation stage (1 - from the 1st to 100th day, 2 - from 101st to 200th day, 3 - after 201st day). 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.

RESULTS AND DISCUSSION

The results of duration of observed maintenance behaviour showed that almost all activities excepting total standing were increasing with the day (Table 1). The differences between days were significant ($P<0.001$). The times of total lying and total ruminating were increasing (336.3 ± 171.1 min. vs. 628.0 ± 181.2 min., 318.0 ± 58.7 min. vs. 325.4 ± 74.1 min., $P<0.001$), the total time of standing decreasing (1103.6 ± 189.5 min. vs. 812.1 ± 197.4 min., $P<0.001$) from the first day to the second day. The cows lay longer on their left sides during both days (Table 1).

Number of appointed variables during the period also differed significantly in day's comparison. Number of periods of total lying, lying on the left and right side, and total ruminating were increasing ($P<0.001$). The opposite course was recorded in the parameters of eating (17.46 ± 3.56 vs. 12.73 ± 3.48, $P<0.001$) and total standing (24.93 ± 4.51 vs. 18.19 ± 4.44, $P<0.001$) (Table 2).

Our results are consistent with these previous studies (Soch *et al*., 1997; Bøe, Faeverik, 2003; Redbo *et al*., 1996; Keyserlingk von *et al*., 2008; Schirmann *et al.*, 2001) and also indicate that regrouping and change of housing together influence lying behaviour and more specifically indicate that changes in lying behaviour due to regrouping are dependent upon changes in stocking density. The variability of the duration and the frequency of lying down are partly due to individual factors, such as the parity of the cow, heat, and partly due to management factors, such as housing type, amount and type of bedding material, and density of animals (Jensen, 1999). Especially primiparous cows, when first exposed to free stalls in a competitive environment at feeding, may have decreased lying time. As showed by Chaplin *et al.* (2000), time of lying is often lower than 6.25 hours per day.

It is possibly because 48 hours observation was too short. According to other authors, changes in behaviour due to regrouping typically returned to normal in approximately 3 days after regrouping (von Keyserlingk *et al*., 2008). It has also been suggested that establishment of a new social order requires approximately one week for dairy cattle (Bøe, Færevik, 2003; DeVries, von Keyserlingk, 2004; Mačuhová *et al.*, 2008).

We did not find significant differences in the stage of pregnancy factor, neither for duration of behaviour nor number of periods (Table 1 and 2). Times and periods, and number of lying tended to be the lowest in the cows of the stage 2 (548.5 ± 219.5 min; 11.94 ± 5.77). In

Table 1: Times of maintenance behaviour (minutes)

Time	Day		P / Significance	
	1	2		
	$\bar{x}$ ± SD	$\bar{x}$ ± SD		
Total lying	336.3±171.1	628.0±181.2	0.0000***	
- left side	196.8±139.4	345.1±153.1	0.0000***	
- right side	139.5±106.1	282.9±160.7	0.0000***	
Total eating	306.1±84.5	302.4±91.9	0.9812	
Total ruminating	318.0±58.7	325.4±74.1	0.0000***	
Total standing	1103.6±189.5	812.1±197.4	0.0000***	
Time	Stage of pregnancy			P / Significance
	1	2	3	
	$\bar{x}$ ± SD	$\bar{x}$ ± SD	$\bar{x}$ ± SD	
Total lying	548.5±219.5	639.0±277.4	565.7±248.9	0.2221
- left side	310.6±166.2	369.3±181.1	303.3±246.3	0.3000
- right side	237.9±155.9	269.7±158.6	262.4±185.5	0.6179
Total eating	314.4±83.9	301.7±98.1	274.3±68.6	0.1662
Total ruminating	364.6±84.4	348.0±89.1	369.0±109.6	0.6379
Total standing	891.7±229.5	801.2±291.3	874.1±254.6	0.1533
Time	Stage of lactation			P / Significance	
	1	2	3		
Total lying	527.7±238.0	706.3±219.7	541.9±233.2	0.0043**	1:2**; 2:3**
- left side	333.6±156.3	410.4±163.3	275.8±200.4	0.0066**	2:3**
- right side	194.1±157.7	295.9±132.6	266.1±167.6	0.0228*	1:2*
Total eating	351.0±73.1	261.1±98.8	293.2±73.3	0.0000***	1:2***; 1:3**
Total ruminating	377.2±83.9	364.1±83.9	349.1±95.9	0.3202	
Total standing	912.0±239.1	733.4±242.5	898.6±231.7	0.0021**	1:2**; 2:3**

*P<0.05; **P<0.01; ***P<0.001; SD = standard deviation
Stage of pregnancy = 1 - non pregnant, 2 - pregnant from the 21st day to five months, 3 - from five to nine months
Stage of lactation = 1 - from the 1st to 100th day, 2 - from 101st to 200th day, 3 – after 201st day

relation to lying, it has been observed that pregnant cows discover left side laterality more (Albright and Arave, 1997), probably because the foetus is positioned towards the right side of the body (Phillips *et al*., 2003).

Comparing behaviour of cows according to stage of lactation we have found that the longest total time of lying was exhibited by animals occurring in stage 2 in contrast to stages 1 and 3 (706.3 ± 219.7 min., 527.7 ± 238.0, 541.9 ± 233.2, P<0.01) (Table 1). Times of eating and total standing had the same course, the longest times were noted in cows of the stage 1 and the shortest in cows classed in the stage 2 (351.0 ± 73.1 min., 261.1 ± 98.8 min., P<0.001; 912.0 ± 239.1 min., 733.4 ± 242.5 min., P<0.01) (Table 1). High yield dairy cows had a shorter lying time than lower yielding cows. Disturbed rest is a stressor that may lead to higher concentrations of cortisol in dairy cattle, and may increase the risk of invasion of welfare and lower milk production (Tančin *et al*., 2007; Sudzinová *et al*., 2007).

Significant differences among stages of lactation were recorded in number of periods of lying activities only. The highest number of periods of total lying (P<0.001), lying on the left and right sides (P<0.01), were registered in cows which occurred in stage 2 (16.44 ± 5.87, 9.04 ± 4.24, 7.41 ± 3.88). In free-stall systems cows

Table 2: Number of periods of maintenance behaviour

Time	Day		P / Significance	
	1	2		
	$\bar{x}$ ± SE	$\bar{x}$ ± SE		
Total lying	7.34±4.54	14.07±4.72	0.0000***	
- left side	4.05±3.48	7.85±3.99	0.0000***	
- right side	3.29±2.86	6.22±3.53	0.0000***	
Total ruminating	14.32±2.83	15.75±2.95	0.0000***	
Total standing	24.93±4.51	18.19±4.44	0.0000***	
Total eating	17.46±3.56	12.73±3.48	0.0000***	
Time	Stage of pregnancy			P / Significance
	1	2	3	
	$\bar{x}$ ± SE	$\bar{x}$ ± SE	$\bar{x}$ ± SE	
Total lying	11.94±5.77	14.53±6.37	12.14±5.50	0.1438
- left side	6.46±4.11	7.87±4.01	6.48±4.93	0.2914
- right side	5.48±3.80	6.57±4.17	5.67±4.48	0.4623
Total ruminating	16.33±3.50	15.83±3.82	16.38±5.00	0.8198
Total standing	18.96±5.99	17.27±7.09	18.76±7.82	0.4921
Total eating	13.68±4.31	12.50±5.16	12.81±4.97	0.4540
Periods	Stage of lactation			P / Significance
	1	2	3	
Total lying	10.77±5.44	16.44±5.87	12.00±5.52	0.0003*** 1:2***; 2:3**
- left side	6.41±3.42	9.04±4.24	6.02±4.45	0.0067** 2:3**; 1:2*
- right side	4.36±3.88	7.41±3.88	5.98±3.88	0.0077** 1:2*
Total ruminating	16.26±3.10	16.44±3.72	16.09±4.37	0.9228
Total standing	18.95±5.90	15.92±5.50	19.44±7.25	0.0641
Total eating	13.92±4.28	12.00±4.80	13.37±4.75	0.2457

*P<0.05; **P<0.01; ***P<0.001; SE = standard deviation
Stage of pregnancy = 1 - non pregnant, 2 - pregnant from the 21st day to five months, 3 - from five to nine months
Stage of lactation = 1 - from the 1st to 100th day, 2 - from 101st to 200th day, 3 – after 201st day

have the opportunity for social contact with other cows, but are often required to compete for access to resources including feed and stalls.

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.

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REFERENCES

ALBRIGHT, J. L. – ARAVE, C. W. 1997. *The behaviour of cattle*. CAB International, 299 p.

BØE, K. E. – FAEREVIK, G. 2003. Grouping and social preferences in calves, heifers, and cows. *Appl. Anim. Behav. Sci.*, vol. 80, 2003, p. 175-190.

BØE, K. E. – BERG, S. – ANDERSEN, I. L. 2006. Resting behaviour and displacements in ewes-effects of reduced lying space and pen shape. *Appl. Anim. Behav. Sci.*, vol. 98, 2006, p. 249-259.

BROUČEK, J. – UHRINČAŤ, M. – ŠOCH, M. – KIŠAC, P. 2008. Genetics of behaviour in cattle. *Slovak J. Anim. Sci*., vol. 41, 2008, p. 166-172.

BROUČEK, J. – UHRINČAŤ, M. – HANUS, A. 2011. Maintenance and competitive behaviour study in dairy calves. *Slovak J. Anim. Sci*., vol. 44, 2011, p. 28-33.

CHAPLIN, S. J. – TIERNEY, G. – STOCKWELL, C – LOGUE, D. N. – KELLY, M. 2000. An evaluation of mattress and mats in two dairy units. *Appl. Anim. Behaviour Sci.*, vol. 66, 2000, p. 263-272.

COOK, N. B. 2003. The Influence of cow comfort on lameness and production. *Proceedings of 16th Annual Fall Symposium on Recent Advances in Clinical Veterinary Medicine*, UC Davis, September 14, 2003, p. 61-70.

DEBRECÉNI, O. – TOČKA, I. – JUHÁS, P. – HALO, M. – BROUČEK, J. 2009. *Ethology of farm animals*. Slovak Agriculture University Nitra, ISBN 978-80-552-0303-4, 2009, 231 p.

DeVRIES, T. J. – KEYSERLINGK von, M.A.G. 2004. Effect of time of feed delivery on the feeding and lying behavior of lactating dairy cows. 2004 Joint Annual Meeting, July 25-29, 2004, St Louis, Missouri. *J. Dairy Sci.*, vol. 87, 2004, Suppl. 1, *J. Anim. Sci*., vol. 82, 2004, Suppl. 1, *Poult. Sci.*, vol. 83, 2004 Suppl. 1, 259 p.

HALEY, D. B. – RUSHEN, J. – DE PASSILLÉ, A. M. 2000. Behavioural indicators of cow comfort: activity and resting behaviour of dairy cows in two types of housing. *Can. J. Anim. Sci*., vol. 80, 2000, p. 257-263.

HVOZDÍK, A. – KOTTFEROVÁ, J. – ALBERTO, J. S. – ONDRAŠOVIČ, M. 2003. Test of social dominance in dogs. *Vet. Archiv*, vol. 73, 2003, p. 237-246.

JENSEN, M. B. 1999. Adaptation to tethering in yearling dairy heifers assessed by the use of lying down behavior. *Appl. Anim. Behav. Sci.*, vol. 62, 1999, p. 115-123.

KEYSERLINGK von, M. A. G. – OLENICK, A. G. D. – WEARY, D. M. 2008. Acute behavioral effects of regrouping dairy cows. *J. Dairy Sci*., vol. 91, 2008, p. 1011-1016.

KEYSERLINGK von, M. A. G. – WEARY, D. 2009. Improving the Welfare of Dairy Cattle: Implications of Freestall Housing on Behavior and Health. *Western Dairy Management Conference*, 2009, March 11-13 Reno, NV, p. 44-52.

KOTTFEROVÁ, J. – NOVACKÝ, M. – MAREKOVÁ, J. – HVOZDÍK, A. 2008. *Veterinary ethology*. ISBN 978-80-8077-101-0, University of veterinary medicine Košice, Vienala s.r.o. Košice, 357 p.

MAČUHOVÁ, L. – UHRINČAŤ, M. – BROUČEK, J. – TANČIN, V. 2008. Reaction of primiparous dairy cows reared in early postnatal period in different systems on milking conditions. *Slov. J. Anim. Sci.*, vol. 41, 2008, p. 98-104.

MUNKSGAARD, L. – SIMONSEN, H. B. 1996. Behavioral and pituitary adrenal-axis responses of dairy cows to social isolation and deprivation of lying down. *J. Anim. Sci*., vol. 74, 1996, p. 769-778.

PHILLIPS, C. J. C. – LLEWELLYN, S. – CLAUDIA, A. 2003. Laterality in bovine behavior in an extensive partially-suckled herd and an intensive dairy herd. *J. Dairy Sci.*, vol. 86, 2003, p. 3167-3173.

REDBO, I. – MOSSBERG, I. – EHRLEMARK, A. 1996. Keeping growing cattle outside during winter: behaviour, production and climatic demand. *Anim. Sci.*, vol. 62, 1996, p. 35-41.

SCHIRMANN, K. – CHAPINAL, N. – WEARY, D. M. – HEUWIESER, W. – KEYSERLINGK von, M. A. G. 2011. Short-term effects of regrouping on behavior of prepartum dairy cows. *J. Dairy Sci*., vol. 94, 2011, p. 2312-2319.

SOCH, M. – KOLAROVA, P. – REHOUT, V. – KOSVANEC, K. – HAJIC, F. – CITEK, J. 1997. Effect of dairy cows moving from tie-stall to loose housing system on their production and behaviour. *Sbornik ZF JU České Budějovice - zootechnicka rada*, 14, 1997, p. 77-86.

SUDZINOVÁ, J. – UHRINČAŤ, M. – MIHINA, Š. – TANČIN, V. 2007. The analysis of milk flow dynamics from udder quarters of cows. *Slov. J. Anim. Sci.*, vol. 40, 2007, p. 204-211.

TANČIN, V. – UHRINČAŤ, M. – MIHINA, Š. – SUDZINOVÁ, J. – FOLTYS, V. – TANČINOVÁ, D. 2007. Somatic cell count and quarter milk flow parameters from udder of dairy cows. *Slovak J. Anim. Sci*., vol. 40, 2007, p. 79-82.