Effect of regrouping Holstein cows on milk production and physical activity

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1. ABSTRACT

Regrouping is a common practice in commercial dairy farms, which might have adverse effects on milk production and cow's welfare. The objective of this study was to evaluate the effect of regrouping dairy cows on milk production and physical activity. Data from 500 lactating cows from the first to the fifth calving (100 cows per each parity number), were obtained from the data base of the farm and analyzed in order to know daily milk production (L d^{-1}) and physical activity (steps^{-h}), two days before, one day before, the day of regrouping, one day after regrouping and two days after regrouping. It was also calculated the correlation between physical activity and milk production There was a drop in milk production of approximately 1 L d^{-1} the day of regrouping compared to the days before relocation, mainly in primiparous cows (P<0.0969). Physical activity increased for all parity numbers (P<0.0001).There was a negative correlation (r= -0.11938, P<0.0489) between milk production (L day^{-1}) and physical activity (steps h^{-1}) for primiparous cows The results found in this study showed that there was a tendency for both primiparous and multiparous cows to reduce their milk production on the day of relocation, and physical activity increased. Regrouping had a higher impact on primiparous than multiparous cows.

2. INTRODUCTION

In a milk herd, the animals are periodically regrouped, according to nutrient intake or state of health (Sevi *et al.*, 2001; Veissier *et al.*, 2001; Boe and Faerevik, 2003). Many cows experience four or more regroupings per lactation. The majority of regrouping events take place before, during, and immediately after the dry period. For example, at the end of lactation the cow may be regrouped to facilitate dry-off. After dry-off, cows are often regrouped into a far-off group, followed by another regrouping into a close-up group at approximately 21 days before calving. Cows are again moved and often regrouped in a maternity pen in the days immediately before parturition, and moved again to a fresh pen immediately after calving when the cow enters the lactating herd (Smith *et al.*, 2001). Each regrouping exposes the cow to new individuals or new combinations of individuals (Schirmann *et al.*, 2011). Regrouping of unfamiliar cows might increase agonistic behaviour (Hasegawa

et al., 1997; von Keyserlingk *et al.*, 2008).This increased agonistic behaviour commonly leads to stress-related behavioural and physiological reactions (González *et al.*, 2003; Miranda-de la Lama *et al.* 2012), social instability (Andersen *et al.*, 2008), reduced feed intake, bodyweight and milk production (von Keyserlingk *et al.*, 2008).

After mixing, cows have a period of social instability while dominance relations are established (Kondo and Hurnik, 1990). The degree and duration of social instability among members of a group may vary depending on animal and environmental factors (Bøe and Faerevik, 2003). Animal factors include breed, age, sex, temperament and the previous mixing experience of individuals, and environmental factors such as feed (feed quality, quantity and accessibility), and space available per animal (Bøe and Faerevik, 2003. These factors also affect the profitability of the production unit (Keeling and Gonyou, 2001; Boe and Faerevik, 2003). The objective of the present study was to evaluate the effect of regrouping dairy cows on milk production and physical activity.

3.   MATERIALS AND METHODS

This experiment was carried out in a dairy farm with approximately 1000 Holstein lactating cows, located in Durango, Mexico. After calving cows are equipped with a pedometer (ENGS Systems) in one of the rear legs in order to measure their physical activity and relocated each time they are regrouped. Milking was done three times per day (5.00, 13.00, and 21.00 h) in a carousel milking parlour. Feed was offered nine times per day, from 4.00 to 22.00 hrs. Data from 500 lactating cows from the first to the fifth calving (100 cows per each parity number), were obtained from the data base of the farm and analyzed in order to know daily milk production (L d^{-1}) and physical activity (steps^{-h}).Two days before regrouping, one day before regrouping, the day of regrouping, one day after regrouping and two days after regrouping. The correlation between physical activity (steps h^{-1}) and milk production was also calculated. Data were analyzed by a randomized block design, using the GLM procedure (SAS,

1999).Mean differences were analyzed by Tukey test. The model was the following:

$$Y_{ijk} = \mu + T_i + \beta j + E_{ijk}$$

Where Y_{ijk} = response variable, μ = general mean, T_i = effect of the *i*th treatment (day of change), βj = effect of the *j*th (parity number) and E_{ijk}= random error.

In order to compare treatments1) two days before regrouping, 2) one day before regrouping, 3) the day of regrouping, 4) one day after regrouping, and 5) two days after regrouping, inside each parity number a complete randomized design was used. Mean differences were analyzed by Tukey test. The model was the following:

$$Y_{ij} = \mu + T_i + E_{ij}$$

Where Y_{ij} = response variable, μ = general mean, T_i = effect of the *i*th treatment (day of change) and E_{ijk}= random error.

The correlation coefficient for milk production and physical activity was calculated using the CORR procedure (SAS, 1999).

4.   RESULTS AND DISCUSSION

The results of daily milk production (L d^{-1}) and physical activity (steps h-1) are shown in Table 1. There were not differences (P>0.05) in milk production. However the average milk production per cow was lower the day of regrouping, in approximately 1 L d^{-1}, increasing the first and second days after regrouping.

Table 1: Milk production (L d^{-1}) and physical activity (steps h^{-1}) of regrouped Holstein lactating cows (n = 500)

Days of regrouping	Milk production	Physical activity
	Mean	Mean
-2	36.25	132.92[c]
-1	36.30	134.33[c]
0	35.05	167.23[a]
1	35.17	143.04[b]
2	35.49	140.71[bc]
Prob.	0.6289	0.0001
SEM	0.438	1.610

[a,b,c;] Different letters in the same column are significant different

-2 = Two days before regrouping, -1 = One day before regrouping, 0 = Day of regrouping, 1 = One day after regrouping, 2 = Two days after regrouping, Prob. = Probability Type I Error (α), SEM = Standard error of the mean

There was a drop in milk production the day of regrouping compared to the days before relocation, this was observed mainly in primiparous and second parity cows, the effect being less marked in cows with more parities. Similar results have been reported by other authors (Broucek *et al.*, 2013), who also found that milk yield after 3-4 days of relocation approached the same level of the day before regrouping. The effect of regrouping on animal productivity is still not well defined. In some studies it has been found a significant reduction of milk production due to regrouping (Broucek *et al.*, 2013), while others (Gupta *et al.*, 2005) conclude that the metabolic system adapts quickly to constant regrouping, and therefore this practice does not affect production nor immunity in animals subjected to it.it. Despite the fact that regrouping has diverse negative effects on animal productivity and disrupts cows´ social behaviour (Phillips and Rind, 2001), this practice is widely used. Grant and Albright (2001) mention that when a group of cows needs to be regrouped, it is necessary to do it in such a way that not only minimize negative social interactions but to encourage positive interactions. Related to parity number, there were no differences (P>0.05) in milk production due to days of regrouping (Table 2).

Table 2: Milk production (L d^{-1}) of regrouped Holstein lactating cows with different parity number (n = 100)

Parity number	Days of regrouping						
	-2	-1	0	1	2	Prob.	SEM
1	33.88	34.22	30.65	31.01	33.64	0.0969	0.79
2	37.19	35.37	34.65	35.21	35.63	0.8220	1.07
3	36.95	37.57	36.65	36.28	36.90	0.9780	1.13
4	39.25	40.82	38.19	40.07	39.22	0.9420	1.06
5	41.43	40.66	39.06	36.15	38.38	0.7995	1.23

-2 = Two days before regrouping, -1 = One day before regrouping, 0 = Day of regrouping
1 = One day after regrouping, 2 = Two days after regrouping, Prob. = Probability Type I Error (α),
SEM = Standard error of the mean

However in first calving cows there was a tendency to decrease milk production (P<0.0969) the day of regrouping, regarding to two days before regrouping. . Phillips and Rind (2001) when mixing primiparous and multiparous cows reported an increased

dominance of multiparous cows, and more aggression in the primiparous cows, that might stress animals which in turn affects milk production.There were differences for physical activity (steps h^{-1}) (P<0.0001) among days, finding the highest physical activity the day of

regrouping, 26% more compared to two days before regrouping. The first day after regrouping, physical activity diminished respect to the day of regrouping for all parity numbers (Table 3)

Table 3: Physical activity (steps^{-1}) of regrouped Holstein lactating cows with different parity number (n = 100)

Parity number	Days of regrouping					Prob.	SEM
	-2	-1	0	1	2		
1	138.44[b]	138.20[b]	173.21[a]	155.96[a]	157.39[a]	0.0001	3.88
2	130.91[b]	129.75[b]	162.85[a]	137.25[b]	133.50[b]	0.0001	2.86
3	129.63[b]	133.12[b]	165.30[a]	131.69[b]	134.06[b]	0.0004	3.51
4	127.13[b]	132.81[b]	164.27[a]	134.54[b]	130.22[b]	0.0004	2.97
5	122.42[b]	122.08[b]	154.17[a]	125.42[b]	124.67[b]	0.0075	2.96

[a,b,c;] Different letters in the same line are significant different

-2 = Two days before regrouping, -1 = One day before regrouping, 0 = Day of regrouping, 1 = One day after regrouping, 2 = Two days after regrouping, Prob. = Probability Type I Error (α), SEM = Standard error of the mean

It is important to point out that in multiparous cows physical activity returned to normal the following day to regrouping, but not for first calving animals, in which physical activity was high even after two days after regrouping (P<0.0001).It has been reported than when animals are mixed physical activity increases (Boyle *et al.*, 2013) and lying times decrease on the day of mixing (Von Keyserlinkg *et al.*, 2008). However other authors have not found differences due to regrouping (Silva *et al.*, 2013). Other studies showed that parity of cows

affects physical activity (Vacek *et al.*, 2010), been lower in older cows, which might explain why in this study both primiparous and multiparous cows increased their activity when they were regrouped, but primiparous cows had a higher physical activity than multiparous ones. The correlation coefficient (r) calculated for milk production (L day^{-1}) and physical activity (steps h^{-1}) (Table 4) showed a negative correlation (r= -0.11938, P<0.0489) for primiparous cows.

Table 4: Correlation coefficient (r) between milk production (L d^{-1}) and physical activity (steps h^{-1}) according to parity number

Parity number	r	Prob.
1	-0.11983	0.0489
2	-0.09869	0.3183
3	-0.09720	0.2142
4	-0.00780	0.9355
5	-0.00791	0.1470
All parities	-0.08581	0.3161

Prob. = Probability Type I Error (α)

However for multiparous cows the correlation was not significant. It was also observed that as parity number increased, the correlation

coefficient between these variables diminished.Older animals are exposed to regrouping several times; therefore these

previous experiences reduce stress in these animals compared to primiparous cows, besides multiple lactation cows usually demonstrate dominance over the younger, first lactation cows (Grant, 2005). First parturition cows have to cope with several changes in their environment that can compromise their welfare and production. In addition to being separated from their calves they have to compete for eating and lying places with older and more experienced cows once they are introduced to a new group which increases stress, as it was demonstrated by Gonzalez et al. (2003), who found lower levels of cortisol after injection of ACTH in adult cows than in first parturition cows. It has also been observed that stress reduces milk production, mainly in first lactating cows (Broucek et al., 2013). Gupta et al (2008) mention that there is partial adaptation of animals in the first two regroupings, followed by total adaptation in the third and later regroupings, while Raussi et al. (2005) suggest that the optimal number of regroupings is between 3 and 12. It is important to consider that the social behaviour of cattle varies with age and maturity (Raussi et al., 2005), and dominance plays an important role (Hasegawa et al., 1997) when regrouping cows. However a social hierarchy helps to reduce conflicts and fighting, therefore it is recommended that heifers are regrouped several occasions to prepare them for integration into the main adult dairy herd.

5. CONCLUSIONS

The results observed in this study showed that when cows were relocated, there was a tendency to reduce cows' milk yield and to increase physical activity. Both primiparous and multiparous cows reduced their milk production on the day of relocation, and physical activity increased. Relocation seemed to have a higher impact on primiparous than multiparous cows.

6. REFERENCES

Andersen, I.L., S. Roussel, E. Ropstad B.O. Braastad, G. Steinheim , A.M. Janczak, G.M. Jorgensen and K.E. Boe. (2008). Social instability increases aggression in groups of dairy goats, but with minor consequences for goats´ growth, kid production, and development. Appl. Anim. Behav. Sci. 114(1-2):132-148..

Boe, K.E. and G. Faerevik. (2003) Grouping and social preferences in calves, heifers and cows. Appl. Anim. Behav. Sci. 80(3): 175-180.

Brouce, K.J., M. Uhrinca, V. Tancin, A. Hanus, P. Tongel, L. Botto and L. Bozik. (2013). Performance and behaviour at milking after relocation and housing change of dairy cows. Czech J. Anim. Sci. 58(9):389-395.

Boyle, A.R., C.P. Ferris and N.E. O´Connell. (2013) Does housing nulliparous dairy cows with multiparous animal prior to calving influence welfare-and production-related parameters after calving?. Appl. Anim. Behav. Sci. 143(1):1-8.

González, M., A.K..Yabuta and F. Galindo. (2003). Behaviour and adrenal activity of first parturition and multiparous cows under a competitive situation. Appl. Anim.Behav. Sci. 83(4):259-266.

Grant, R.L. and J.L.Albright. (2001). Effect of animal grouping on feeding behaviour and intake of dairy cattle. J. Dairy Sci. 84(E Suppl.):E156-E163.

Grant, R.L. (2005). Incorporating dairy cow behaviour into management tools. http.//milkproduction.com. Accessed July 16, 2014.

Gupta, S.B., B. Earley, N. Nolan, E. Formentin and M.A. Crowe. (2008). Effect of repeated regrouping and relocation on behaviour of steers. Appl. Anim. Behav. Sci.110 (3-4):229–243.

Gupta, S.B., B. Earley, S.T.L. Ting and M.A. Crow. (2005). Effect of repeated regrouping and relocation on the physiological, immunological and ethological variables and performance of steers. J. Anim. Sci. 83 (8):1984-1958.

Hasegawa, N., A. Nishiwaki, K. Sugawara and I. Ito. (1997). The effects of social exchange between two groups of lactating primiparous heifers on milk production, dominance order, behaviour and adrenocortical response. Appl. Anim.Behav. Sci. 51(1-2):15-27.

Keeling, L.J. and H.W. Gonyou. (2001). Social Behaviour in Farm Animals. CABI International, Wallingford, Oxon (United Kingdom).432 p

Kondo, S. and J.F. Hurnick (1990). Stabilization of social hierarchy in dairy cows. Appl. Anim.Behav. Sci. 27(4):287-297.

Miranda de la Lama, G.C., M. Villaroel and G.A. Maria. (2012). Behavioural and physiological profiles following exposure to novel environment and social mixing in lambs. Small Rumin. Res. 103(2-3):158-163.

Phillips, C.J.C. and M.I. Rind. (2001). The effects on production and behaviour of mixing uniparous and multiparous cows. J. Dairy Sci. 84(11):2424-2429.

Raussi, S., A. Boissy, E. Delval, P. Pradel, J. Kaihilahti and I. Veissie . (2005). Does repeated regrouping alter the social behaviour of heifers?. Appl. Anim. Behav. Sci. 93(1-2):1–12.

SAS (Statistical Analysis System). (1999). Statistical Analysis System Institute Inc., NC, USA.

Sevi, A., L. Taibi, M. Albenzio , A. Muscio, S. Dell'Aquila and F. Napolitano.(2001). Behavioural, adrenal, immune, and productive responses of lactating ewes

to regrouping and relocation. J. Anim. Sci. 79(6):1457–1465.

Schirmann, K.., N. Chapinal, D.M. Weary, W. Heuwieser and M.A.G. von Keyserlingk (2011).Short-term effects of regrouping on behaviour of prepartum dairy cows. J. Dairy Sci.94(5):2312–2319.

Silva, P.R.B., J.G.N. Moraes, L.G.D. Mendonca, A.A. Scanavez, G. Nakagawa, J. Fetrow, M.I. Endres and R.C. Chebel. (2013). Effects of weekly regrouping of prepartum dairy cows on metabolic, health, reproductive, and productive parameters. J. Dairy Sci. 96(12):4436-4446.

Smith, J.F., J.P. Harner III and M.J. Brouk. (2001). Special needs facilities. Recommendations for housing, lactating and sick cows. Kansas State University Agricultural Experimental Station and Cooperative Extension Service EP100, Manhattan, KS (United States).

Vacek, M, Z. Najmanova, L. Stadnik and M. Kubesova. (2010). Relationship among locomotion score of dairy cows and their feed intake and milk production and fertility. The First North American Conference on Precision Dairy Management 2010.March 2-5, 2010, Toronto (Canada).

Veissier, I., A. Boissy , A.M. de Passille, J. Rushen , C.G. van Reenen, S. Roussel, S. Andanson and P. Pradel. (2001). Calves' responses to repeated social regrouping and relocation. J. Anim. Sci. 79(10):2580–2593.

Von Keyserlingk, M.A.G., D. Olenick and D.M. Weary. (2008). Acute behavioural effects of regrouping dairy cows. J. Dairy Sci. 91(3):1011-1016.