ACTA UNIVERSITATIS AGRICULTURAE ET SILVICULTURAE MENDELIANAE BRUNENSIS

Volume 67 100 Number 5, 2019

CHANGES OF THE RUMINATION CHARACTERISTICS IN DAIRY COWS AFTER CHANGE TMR COMPOSITION

Peter Juhás[1], Katarína Špulerová[1], Klára Vavrišínová[1], Katarína Hozáková[1], Peter Strapák[1]

[1] Department of Animal Husbandry, Faculty of Agrobiology and Food Resources, Slovak University of Agriculture in Nitra, Tr. A. Hlinku 2, 949 76 Nitra, Slovak Republic

To link to this article: https://doi.org/10.11118/actaun201967051153
Received: 22. 7. 2019, Accepted: 2. 9. 2019

To cite this article: JUHÁS PETER, ŠPULEROVÁ KATARÍNA, VAVRIŠÍNOVÁ KLÁRA, HOZÁKOVÁ KATARÍNA, STRAPÁK PETER. 2019. Changes of the Rumination Characteristics in Dairy Cows After Change TMR Composition. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis,* 67(5): 1153–1157.

Abstract

Rumination behavior in cattle is important for health and reproduction management of herd. The aim of presented paper was to evaluate change in rumination behavior in dairy cattle after changing total mixed ration (TMR) composition. Twenty-eight multiparous Red Holstein dairy cows were observed during rumination in first month after calving and in fourth month after calving. Cows were fed different total mixed ratio at beginning of lactation in first month after calving (TMR1) and in mid of lactation period in fourth month after calving (TMR2). TMR2 has higher content of roughage. Length of the single rumination period and number of jaw movements during rumination one bolus were recorded. Frequency of jaw movement per minute was calculated from recorded rumination characteristics. Rumination of one bolus TMR2 was longer (TMR1 = 53.97 ±8.241 sec, TMR2 = 57.57 ±6.290 sec) and cow perform more jaw movements (TMR1 = 61.0 ±10.674, TMR2 = 65.99 ±9.682) than ruminating bolus TMR1. Difference in duration of rumination one bolus as well as number of jaw movement was significant ($P < 0.001$). Frequency of jaw movement was not significantly affected ($P > 0.05$) and seem to be intra-individual stable. Rumination evaluated by correlation of rumination characteristics for TMR1 and TMR2 was intra-individual stable despite of changes in times of jaw movement and duration of one bolus rumination.

Keywords: dairy cattle, frequency, jaw movement, Red Holstein, rumination

INTRODUCTION

The ruminating is part of feeding behavior in ruminants, different form other animals. Its functions are to reduce feed particle, to increase particle surface/volume ratio, to improve microbial access and feed degradation, to facilitate passage of undigested residues of feed, to stimulate secretion of saliva as well as to maintain rumen pH (Poppi and Norton, 1980; Welch, 1982; Beauchemin, 1991; McAllister *et al*., 1994; Mertens, 1997; Watt *et al*., 2015; Fustini *et al*., 2017). Cattle spend approximately 8 hours per day ruminating usually, but times up to 12 hours per day are reported (Welch, 1982; Beauchemin, 1991; Albright 1993; Melin *et al*., 2007; DeVries *et al*., 2009; Suarez-Mena *et al*., 2013; Liboreiro *et al*., 2015). The number of jaw movement during chewing one bolus range from 50–80 usually but depending on feedstuff can vary from 20 to 400 chews (McLeod and Smith, 1989; Melin *et al*., 2007; Rombach *et al*., 2018). The times that the bolus is chewed and the number of jaw movement is relatively stable and constant for an individual. Increasing of fiber content in ratio is resulting in increasing number of chews per bolus and in faster chewing (Beauchemin and Buchanan-Smith, 1989; McLeod and Smith, 1989; Moon *et al*., 2004). Frequency of chewing while

I: *Composition of TMR 1 in first month and TMR 2 in fourth month after calving in kg per cow per day*

	Alfalfa hay	Corn silage	Alfalfa silage	Beet pulp	CCM	WDDG	Soya HP	Rapeseed cake	Calcitic limestone	Concetrate	Total	Energy [MJ*day^{-1}]
TMR 1	0.6	18.0	5.0	0.0	1.6	1.6	1.6	0.0	0.1	5.8	34.3	111.0
TMR 2	0.6	22.0	9.0	2.0	2.4	2.4	1.3	0.8	0.0	8.0	48.5	164.0

CCM – corn cob mix, WDDG – wheat dried distillers grain.
TMR was top-dressed with molasses at feeding table.

feeding is more erratic and varies from 10–70 chews per minute, slower is at the beginning and at the end of the ruminating period (Melin *et al*., 2007). Chewing activity and its automatic monitoring for the dairy cattle management is widely used in recent years (Elischer *et al*., 2013; Tani *et al*., 2013; Ambriz-Vilchis *et al*., 2015; Liboreiro *et al*., 2015; Pahl *et al*., 2015; Reiter *et al*., 2018; Rombach *et al*., 2018). Because use for management purposes the stability of chewing while the ruminating in cows without changes in health or reproductive status is very important. Aim of present study was evaluate a change and interindividual stability of rumination characteristic in dairy cattle after composition change of TMR between the first month after calving (TMR 1) and the fourth month after calving (TMR 2).

MATERIALS AND METHODS

Animals, Housing and Experimental Design

The study was carried out at the Agri-coop Kočín at Šterusy Farm (Piešťany District, Trnava Region, Slovakia). The farm has 700-cow Red Holstein milking herd. All procedures related to animals were performed in accordance with guidelines of the Slovak University of Agriculture Ethics Committee. Twenty-eight multiparous Red Holstein dairy cows were used for experiment (mean parity 3.04 ± 1.036, mean age at beginning of experiment 1592.39 ± 406.733 days). Primiparous cows were not included because of difference in rumination between cows in first lactation and more mature cows (Welch, 1982; Pahl *et al*., 2015) Animals for observation were at beginning of lactation, selected by date of calving. All selected cow was healthy, without any metabolic diseases, claw, leg or reproduction problems. Cows were housed in same stall in same pen. The cubicles and stall alley were cowered with rubber matrasses top-dressed with limestone dust. There were 3 water troughs in pen, forage was offered at feed table. Cows were fed a corn silage TMR once a day for ad libitum consumption. Behavior observation was performed twice, the first observation was in the first month after calving (mean DIM 19.68 ± 1.124) and the second observation in the fourth month after calving (mean DIM 104.64 ± 3.654). Composition of TMR1 was different from TMR2. TMR2 had higher content of roughage (Tab. I).

Data Collection

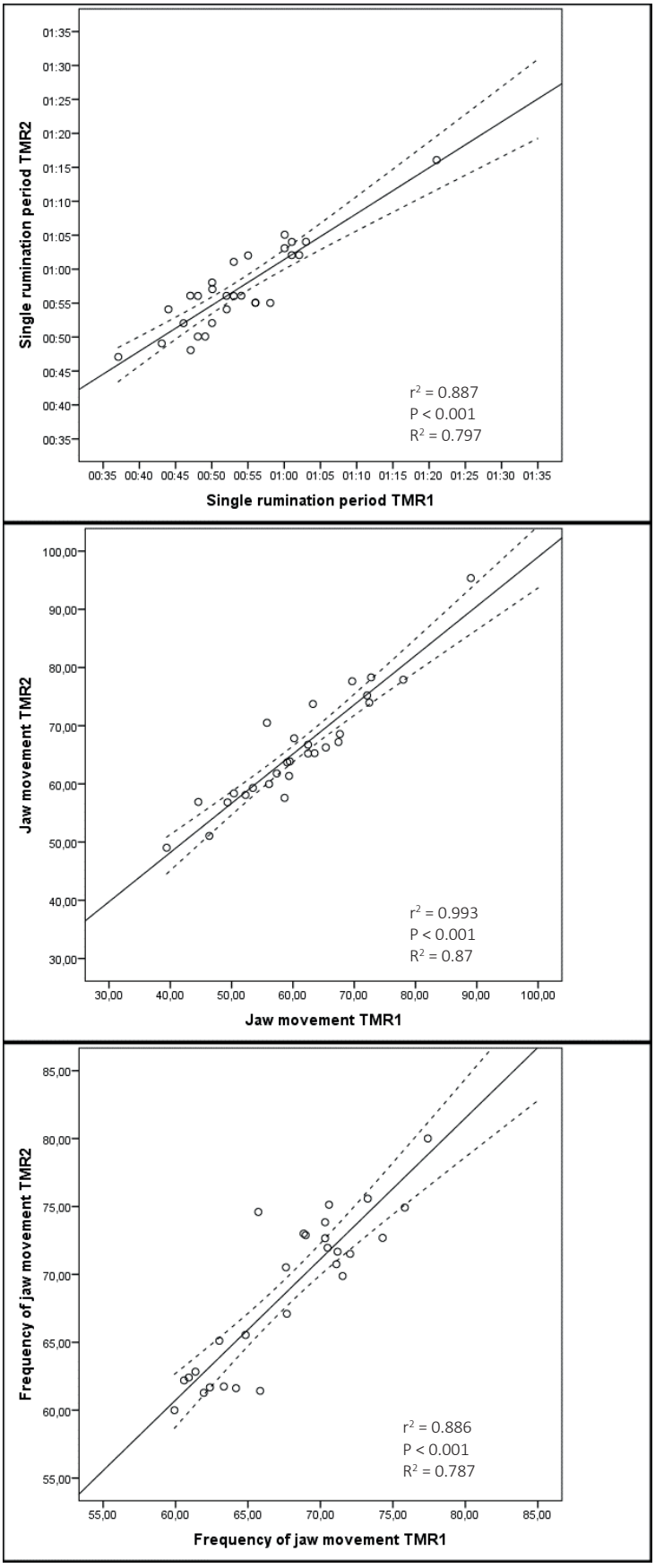
Three rumination characteristics were evaluated: length of one bolus (single rumination period SRP), number of jaw movements (JM) during one SRP and frequency of jaw movements (FJM) during rumination. Rumination activity was observed by the direct visual observation method after morning feeding, between 8.00am – 10.00am. Observer was positioned outside the pen. Before the first live recording was trained for recognition and observation of rumination. For each cow 30 SRPs were recoded. The SRP starts with the regurgitation bolus and ends with the swallowing. The number of JM and the duration was recorded for each the SRP. The duration of the SRP was recorded manually by the stopwatches. The FJM was calculated from the recorded number of JM and the duration of the SRP.

Statistical Analysis

The mean values from 30 records of the SRPs were calculated for each dairy cow. All statistical analysis was carried out using the mean values. Effect of the parity to rumination characteristics in the dairy cows was tested by using the Univariate Analysis of Variance (ANOVA). Difference among the cows at different parity was not found and the parity was disregarded in all other analysis. Difference in rumination characteristics between first and fourth month after calving was tested by the Paired Samples t-Test. Intra-individual stability of the rumination characteristic in first and fourth month after calving was evaluated by Pearson correlation coefficient. All statistical calculations were performed using IBM SPSS 20.

RESULTS AND DISCUSSION

The average duration of the SRP in cows fed TMR1 was 53.97 sec, SD = 8.241 sec. The average number of JM was 61.0 ±10.674. As was expected, because change of roughage in TMR2, the average duration of the SRP in cows fed TMR2 was longer and number of JM was higher (57.57 ±6.290 sec and 65.99 ±9.682 JM). The rumination characteristics recorded in present paper are similar as reported in published studies as well as changes in SRP and JM between TMR1 and TMR2 (Beauchemin and Buchanan-Smith, 1989; McLeod and Smith, 1989; Moon *et al*., 2004; Melin *et al*., 2007). Differences in duration of rumination the SRP as well as number JM were statistically different (SRJ t = -4.829



1: *Correlation rumination characteristics between TMR1 and TMR2*

P < 0.001, JM t = -6.846 P < 0.001). Frequency of chewing is dependent on SRP and JM so the average FJM was slightly changed between TMR1 and TMR2 (average FJM 67.70 ±4.916 JM per minute and 68.73 ±5.754 JM per minute respectively). Because relatively small change in FJM (1.5%) in comparison with changes in SRP (8.2%) and JM (6.7%) difference in FJM is not statistically significant (t = -1.973, P > 0.05). Similar changes in frequency of chewing with changes in roughage content suggest Beauchemin and Buchanan-Smith (1989), McLeod and Smith (1989), Melin *et al.* (2007), Moon *et al.* (2004) and Tani *et al.* (2013). The rumination characteristics and its change in individual cows was relative stable between TMR1 and TMR2, accordant with Beauchemin and Buchanan-Smith (1989), McLeod and Smith (1989) and Moon *et al.* (2004). Correlation SRP, JM and FJM between TMR1 and TMR 2 was higher than 0.886 (Fig. 1).

CONCLUSION

Change in TMR composition brings change in behavior during rumination. Highest content of roughage in TMR leads to lengthening of duration of rumination of bolus as well as to increasing number of jaw movements during ruminating one bolus. Number of jaw movements per minute is not affected and seem to be intra-individual stable. Despite changes in rumination behavior, inter-individual difference is relative stable. It can be concluded frequency of rumination can be used for management use as one of measure together with length of rumination periods.

Acknowledgements

Presented work was supported by grants VEGA 1/0724/16 and KEGA 015SPU-4/2019.

REFERENCES

ALBRIGHT, J. L. 1993. Feeding Behavior of Dairy Cattle. *Journal of Dairy Science*, 76(2): 485–498.

AMBRIZ-VILCHIS, V., JESSOP, N. S., FAWCETT, R. H., SHAW, D. J. and MACRAE, A. I. 2015. Comparison of rumination activity measured using rumination collars against direct visual observations and analysis of video recordings of dairy cows in commercial farm environments. *Journal of Dairy Science*, 98(3): 1750–1758.

BEAUCHEMIN, K. A. 1991. Ingestion and mastication of feed by dairy cattle. *Veterinary Clinics of North America: Food Animal Practice*, 7(2): 439–462.

BEAUCHEMIN, K. A. and BUCHANAN-SMITH, J. G. 1989. Effects of Dietary Neutral Detergent Fiber Concentration and Supplementary Long Hay on Chewing Activities and Milk Production of Dairy Cows. *Journal of Dairy Science*, 72(9): 2288–2300.

DEVRIES, T. J., BEAUCHEMIN, K. A., DOHME, F. and SCHWARTZKOPF-GENSWEIN, K. S. 2009. Repeated ruminal acidosis challenges in lactating dairy cows at high and low risk for developing acidosis: Feeding, ruminating, and lying behavior. *Journal of Dairy Science*, 92(10): 5067–5078.

ELISCHER, M. F., ARCEO, M. E., KARCHER, E. L. and SIEGFORD, J. M. 2013. Validating the accuracy of activity and rumination monitor data from dairy cows housed in a pasture-based automatic milking system. *Journal of Dairy Science*, 969(10): 6412–6422.

FUSTINI, M., PALMONARI, A., CANESTRARI, G., BONFANTE, E., MAMMI, L., PACCHIOLI, M. T., SNIFFEN, G. C. J., GRANT, R. J., COTANCH, K. W. and FORMIGONI, A. 2017. Effect of undigested neutral detergent fiber content of alfalfa hay on lactating dairy cows: Feeding behavior, fiber digestibility, and lactation performance. *Journal of Dairy Science*, 100(6): 4475–4483.

LIBOREIRO, D. N., MACHADO, K. S., SILVA, P. R. B., MATURANA, M. M., NISHIMURA, T. K., BRANDÃO, A. P., ENDRES, M. I. and CHEBEL, R. C. 2015. Characterization of peripartum rumination and activity of cows diagnosed with metabolic and uterine diseases. *Journal of Dairy Science*, 98(10): 6812–6827.

MCALLISTER, T. A., BAE, H. D., JONES, G. A. and CHENG, K.-J. 1994. Microbial attachment and feed digestion in the rumen. *Journal of Animal Science*, 72(11): 3004–3018.

MCLEOD, M. N. and SMITH, B. R. 1989. Eating and ruminating behaviour in cattle given forages differing in fibre content. *Animal Production*, 48(3): 503–511.

MELIN, M., PETTERSSON, G., SVENNERSTEN-SJAUNJA, K. and WIKTORSSON, H. 2007. The effects of restricted feed access and social rank on feeding behavior, ruminating and intake for cows managed in automated milking systems. *Applied Animal Behavior Science*, 107(1–2): 13–21.

MERTENS, D. R. 1997. Creating a System for Meeting the Fiber Requirements of Dairy Cows. *Journal of Dairy Science*, 80(7): 1463–1481.

MOON, Y. H., LEE, S. C. and LEE, S. S. 2004. Effects of Neutral Detergent Fiber Concentration and Particle Size of the Diet on Chewing Activities of Dairy Cows. *Asian-Australasian Journal of Animal Sciences*, 17(11): 1535–1540.

PAHL, C., HARTUNG, E., MAHLKOW-NERGE, K. and HAEUSSERMANN, A. 2015. Feeding characteristics and rumination time of dairy cows around estrus. *Journal of Dairy Science*, 98(1): 148–154.

POPPI, D. P. and NORTON, B. W. 1980. The validity of the critical size theory for particles leaving the rumen. *Journal of Agricultural Science*, 94(2): 275–280.

REITER, S., SATTLECKER, G., LIDAUER, L., KICKINGER, F., ÖHLSCHUSTER, M., AUER, W., SCHWEINZER, V., KLEIN-JÖBSTL, D., DRILLICH, M. and IWERSEN, M. 2018. Evaluation of an ear-tag-based accelerometer for monitoring rumination in dairy cows. *Journal of Dairy Science*, 101(4): 3398–3411.

ROMBACH, M., MÜNGER, A., NIEDERHAUSER, J., SÜDEKUM, K.-H. and SCHORI, F. 2018. Evaluation and validation of an automatic jaw movement recorder (RumiWatch) for ingestive and rumination behaviors of dairy cows during grazing and supplementation. *Journal of Dairy Science*, 101(3): 2463–2475.

SUAREZ-MENA, F. X., LASCANO, G. J. and HEINRICHS, A. J. 2013. Chewing activities and particle size of rumen digesta and feces of precision-fed dairy heifers fed different forage levels with increasing levels of distillers grains. *Journal of Dairy Science*, 96(8): 5184–5193.

TANI, Y., YOKOTA, Y., YAYOTA, M. and OHTANI, S. 2013. Automatic recognition and classification of cattle chewing activity by an acoustic monitoring method with a single-axis acceleration sensor. *Computers and Electronics in Agriculture*, 92: 54–65.

WATT, L. J., CLARK, C. E. F., KREBS, G. L., PETZEL, C. E., NIELSEN, S. and UTSUMI, S. A. 2015. Differential rumination, intake, and enteric methane production of dairy cows in a pasture-based automatic milking system. *Journal of Dairy Science*, 98(10): 7248–7263.

WELCH, J. G. 1982. Rumination, particle size and passage from the rumen. *Journal of Animal Science*, 54(4): 885–894.

Contact information

Peter Juhás: Peter.Juhas@uniag.sk
Katarína Špulerová: katarina.spulerova@gmail.com
Klára Vavrišínová: Klara.Vavrisinova@uniag.sk
Katarína Hozáková: k.supekova@gmail.com
Peter Strapák: Peter.Strapak@uniag.sk