Potravinarstvo® Scientific Journal for Food Industry

Potravinarstvo, vol. 8, 2014, no. 1, p. 135-140
doi:10.5219/318
Received: 18 February 2014. Accepted: 18 February 2014.
Available online: 25 June 2014 at www.potravinarstvo.com

ISSN 1337-0960 (online)

THE EFFECT OF EWES RELOCATION ON MILK COMPOSITION AND MILK FLOW KINETICS

Lucia Jackuliaková, Vladimír Tančin, Michal Uhrinčať, Lucia Mačuhová, Ján Antonič, Marta Oravcová, Petr Sláma

ABSTRACT

The investigation of an influence of ewes relocation and milking in other parlour (treatment) on milk flow kinetics, milkability and milk composition was the aim of this study. In total 34 ewes of two breeds and crosbreeds Tsigai (14 heads) and Improved Valachian (20 heads) with Lacaune were tested. Two weeks after lamb weaning the ewes were milked in parallel milking parlour (1x16 stalls) under shelter. On the last evening milking (first experimental milking, EB) before relocation of flock to another parlour, and during next three continuous evening milkings (E0 - second, E1 - third and E2 - fourth milking of exp.) after relocation the milk flow kinetics were measured using electronic collection jar. On day E0 after morning milking the flock was moved on a pasture and milked in other parlour (1x24-stalls). During E0 we recorded a significant decrease of total milk yield in comparison with EB (0.527 ± 0.04 and 0.647 ± 0.04 L). Significant differences were also recorded in machine milk yield, machine stripping, milking time and in maximum milk flow rate. During E0 there was a higher number of nonbimodal and lower numbers of bimodal flow types. The response of ewe to E0 depended on its response to EB. Ewes with bimodal flow at EB responded more negatively to E0 than ewes with nonbimodal or plateau flow. During E2 there were significantly increased protein content and solids not fat in milk. Thus the treatment significantly influenced the milkability of ewes in a negative way, but more clear response was found out in ewes with bimodal flow response to machine milking before treatment. We could assume that relocation to other milking conditions caused only short-term changes in milk flow kinetic and milk yield.

Keywords: milk flow kinetic; relocation; adaptation of ewes

INTRODUCTION

For fast and complete milk removal, in of spite larger volume of cistern in ewes, the milk ejection reflex occurrence is also needed **(Labusiere, 1981)** as it is well presented for dairy cows **(Tančin and Bruckmaier, 2001)**. In ewes of lower milk yield the milk ejection is often observed as a second emission of milk during milking causing a bimodal milk flow kinetics **(Mačuhová et al., 2008, 2012; Rovai et al., 2008; Tančin et al., 2011)** due to oxytocin release in response to udder stimulation by machine and its effect to expulse of alveolar milk to cistern **(Bruckmaier et al., 1997)**. However, under the normal milking conditions there are many ewes of main Slovak breeds (around 40%) with only one emission, which indicates no response to udder stimulation **(Tančin et al., 2011)**.

Under the various milking conditions and manipulation with ewes the milk ejection reflex could be disturbed causing inhibition of second emission occurrence **(Kulinová et al., 2012)**. Inhibition of second emission causes lower milk and fat yield **(Antonič et al., 2013)**. It was also confirmed that despite of larger cisternal volume in ewes, milk ejection reflex and also complete milk removal from udder is very important to keep milk production due to the effect of milk born feedback mechanisms **(Silanikove et al., 2010)**.

The ewe's relocation to new milking conditions is one of the possible stress factors for milk removal. The change of surroundings and milking conditions caused milk flow failures in dairy ewes **(Marnet et al., 1998)** and cows **(Mačuhová et al., 2002; Tančin et al., 2004)**. Because of high individual variability of milk ejection occurrence in response to machine milking under normal conditions **(Tančin et al., 2011)** we could expect different response of ewes to milking under stress conditions. The aim of the work was to study the effect of relocation and milking in other parlour on milk flow kinetic, milkability parameters and milk composition. The importance of differed milk flow kinetic of ewes under the control milking conditions to mentioned stress load was evaluated as well.

MATERIAL AND METHODOLOGY

Experimental conditions and design

Experiment was performed on 34 experimental ewes of two breeds and crossbreeds Tsigai (14 heads, two of them pure Tsigai, and others were crosbreed with Lacaune from 25-75) and Improved Valachian (20 heads, three of them pure IV, and others were crosbreed with Lacaune from 25-75). Ewes were randomly selected from the flock and used for experimental purposes two weeks after lambs weaning in April. During these two weeks the flock was milked in parallel milking parlour (1x16 stalls) under shelter with following parameters: pulsation rate

120 cycles per min., milking vacuum 52 kPa, pulsation ratio 50:50. On the last evening milking, (first experimental milking, evening before relocation - **EB**) before relocation of flock to another milking parlour, the milk flow kinetics of experimental ewes were measured using electronic collection jar (described below). After the following morning milking the flock was moved on a pasture and milked in another milking parlour (1x24-stalls) with 12 standard milking units and with following parameters: pulsation rate 180 cycles per min., milking vacuum 40 kPa and pulsation ratio 50:50. Milk flow kinetic of experimental ewes was recorded during the next three continuous evening milkings after relocation **(E0 - second, E1 - third** and **E2 - fourth milking of experiment)**. Thus data from four continuous evening milkings (one before and three after relocation) were available for statistical evaluation.

During the whole experiment the ewes were fed by concentrate 0.5 kg and 0,2 kg oat grain at milking parlour and before relocation they received oat silage (6 kg) and hay (0,5 kg) and after relocation they were on meadow pasture (7 kg).

On the basis of milk flow kinetics during EB the ewes were divided into three groups for statistical evaluation. The first group was represented by animals with bimodal (2 emissions) milk flow curve (**BG,** n=12), in the second group were animals with non-bimodal (1 emission) milk flow curve (**NG,** n=10) and the last one was represented by animals with plateau (steady) milk flow curve (**PLG,** n=12) to test the importance of differed milk flow kinetics of ewes under the control milking conditions to mentioned stress - relocation and milking in another parlour.

Milk flow recording and parameters

Milk flow kinetics was recorded individually by using four electronic jars (1.5 L each) collecting total milk produced at the milking. Within each jar there was a 2-wire compact magnetostrictive level transmitter (Nivotrack, Nivelco Ipari Elektronika Rt, Budapest, Hungary) connected with the computer. Milk level in the jar was continuously measured by a transmitter recording signal on the computer every second. Measured changes of height level of milk were transformed into values, from which were detected parameters of milkability (TMY - total milk yield, MMY - machine milk yield, MS - machine stripping, MT - milking time, LT - latency time, MMF - maximum milk flow rate) and types of milk flow (B - bimodal, two emissions, N - nonbimodal, one emision, PL - plateau, steady flow, PLL - plateau with low peak flow) were evaluated according to **Bruckmaier et al., (1997); Mačuhová et al. (2008)** and **Rovai et al., (2008)**. During experiment the samples of milk were taken for analysis of basic milk components (fat, protein, lactose, dry matter, solids not-fat) with MilkoScan FT120 (Foss, Hillerød, Denmark) and log SCC with Somacount 150. There were 136 samples of milk for analysis collected in total.

Statistical analysis

Data from four evening milkings were evaluated statistically using mixed model (Mixed procedure; **SAS/STAT 9.1,** 2002-2003). This model was applied to study the influence of the sources of variation in studied traits (milk production and milk emission/milkability).

$y = X\beta + Zu + e$

where:

y = vector of studied traits: TMY (L), MMY (L), MS (L), MT (s), LT (s), maximum milk flow (L/min), fat (%), fat in dry matter (%), protein (%), lactose (%), solids not fat (%), dry matter (%), somatic cells count (log)

β = vector of unknown fixed effects: flow type (bimodal, non-bimodal, plateau), day of milking (four evening milkings described above),

u = vector of random effect of ewe, $u \sim N(0, I\sigma_w^2)$

e = residual vector, $e \sim N(0, I\sigma_e^2)$

X, Z = incidence matrices for fixed effects and random ewe effect.

RESULTS AND DISCUSSION

Relocation and milking in another parlour significantly influenced the TMY between EB (evening before) and E0 (evening after morning ewes relocation) what pointed to stress from changed milking conditions (Table 1). Next two milkings showed adaptation to milking conditions. A statistically significant increase was also in E1 compared to E0 for MMY (Table 1). Statistically significant differences were also recorded in MT. Thus relocation of ewes and their milking in another place significantly influenced milkability. The effect of ewes' relocation on TMY was also confirmed by others authors in ewes or cows **(Sevi et al., 2001; Mačuhová et al., 2002)**.

MS and MMF were also significantly influenced by treatment but changes did not corresponded to the changes of above mentioned parameters. The volume of milk obtained by machine stripping and maximal milk flow are significantly positively influenced by the vacuum level **(Sinapis et al., 2000, 2006)**. Thus higher MS and MMF were caused by higher vacuum level at EB milking. Therefore we are aware of possible effect of changed milking parameters on the response of ewes to the relocation and milking in another parlour.

As it was mentioned above TMY was significantly lower in E0 in comparison to EB and E2 (Figure 1). This physiological response of ewes to the change of milking place supports also high occurrence of N milk flow type in E0 milking (Figure 1). High occurrence of N milk flow type could indicate inhibition of oxytocin release as a consequence of stress effect. The higher occurrence of N type of milk flow during stress response in ewes was found by other authors as well **(Marnet et al., 1998; Kulinová et al., 2012)** or in cows during milking in unfamiliar surroundings **(Mačuhová et al., 2002)**. Relatively higher frequency of N milk flow type during EB milking could be explained by higher vacuum level at parallel milking parlour under shelter causing faster milk flow from cistern.

Table 1 The effect of change of milking conditions and milking parlour (treatment) on parameters of milkability

Milking (n=34)					
Factor	**EB**	**E0**	**E1**	**E2**	**P**
TMY, (L)	0.647 ±0.04^{A}	0.527 ±0.04^{Ba}	0.576 ±0.04^{B}	0.593 ±0.04^{b}	0.000
MMY, (L)	0.341 ±0.03	0.272 ±0.03^{A}	0.374 ±0.03^{B}	0.384 ±0.03^{B}	0.000
MS, (L)	0.305 ±0.03^{A}	0.256 ±0.03^{a}	0.198 ±0.03^{Bb}	0.209 ±0.03^{B}	0.000
MT, (s)	60 ±7^{a}	59 ±7^{a}	87 ±7^{b}	70 ±7	0.008
LT, (s)	18 ±5	19 ±5	27 ±5	21 ±5	0.456
MMF, (L)	1.412 ±0.12^{A}	1.133 ±0.13	0.818 ±0.12^{B}	0.909 ±0.12^{B}	0.000

Total milk yield, machine milk yield, machine stripping, milking time, latency time, maximal milk flow, Evening milking before treatment (EB), on day of treatment (E0) and next two milkings (E1, E2).
$^{A, B}$ Means differ at *P <0.001, P <0.01,* $^{a, b}$ Means differ at *P <0.05*

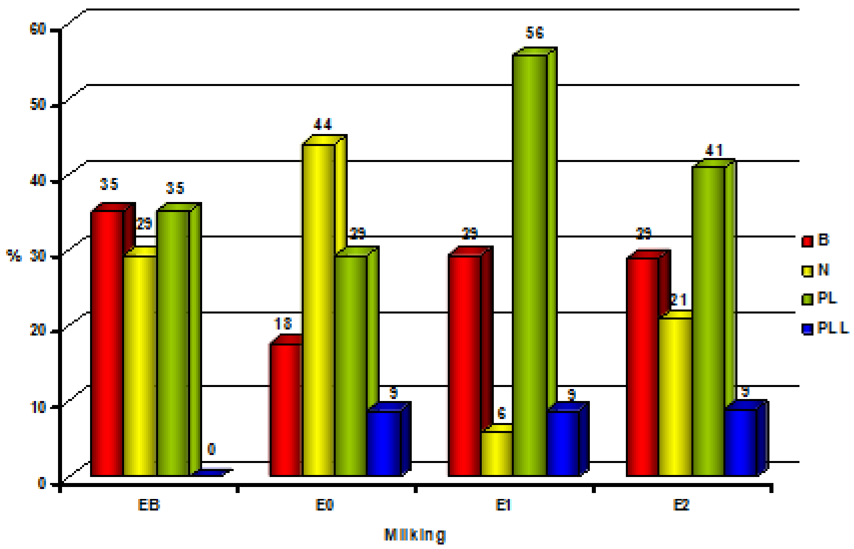

Figure 1 Frequency of distribution of milk flow types influenced by change of milking conditions and milking parlour

From more detail point of view the response of ewes to treatment was different on the basis of their sorting into groups. Within all groups, which were divided according to milk flow type (BG, NG, PLG) during first experimental milking (EB), frequency of milk flow types was changed as shown on Figure 2 A, B, C. The highest change of milk flow kinetic was observed in BG (Figure 2 - A) and the lowest change in B (Figure 2 - B) in response treatments.

Bruckmaier et al., (1993) and **Mačuhová et al. (2002)** observed strong disruption of oxytocin released in machine milking of cows in unfamiliar surroundings. Adaptation of primiparous ewes to machine milking was accompanied by reduced or inhibited oxytocin release **(Negrao and Marnet, 2003)**. Therefore we expected that ewes with B milk flow at EB milking will response more clearly due to inhibition of oxytocin release and thus changing of milk flow from B to N type. This was clearly confirmed in ewes in BG. It seams that ewes with B milk flow type could be considered as suitable animals because they represent the ewes with physiological response to machine milking and also with pathophysiological response to the change of milking conditions. Therefore these animals could be used forthe study the effect of milking management on milkability of ewes **(Mačuhová et al., 2012)**.

Table 2 The effect of change of milking conditions and milking parlour (treatment) on base milk components

Milking (n=34)					
Factor	**EB**	**E0**	**E1**	**E2**	**P**
fat (%)	7.22 ± 0.21	-	7.49 ± 0.21	7.44 ± 0.21	0.237
protein (%)	5.33 ± 0.1^{A}	-	5.34 ± 0.1^{a}	5.51 ± 0.1^{Bb}	0.002
lactose (%)	4.91 ± 0.05	-	4.93 ± 0.05	4.89 ± 0.05	0.623
SNF (%)	11.08 ± 0.10^{a}	-	11.12 ± 0.10	11.26 ± 0.10^{b}	0.043
DM (%)	18.04 ± 0.24	-	18.32 ± 0.24	18.44 ± 0.25	0.106
log SCC	5.37 ± 0.11	-	5.53 ± 0.11	5.46 ± 0.11	0.346

SNF - Solid non fat, DM - dry matter, SCC - somatic cell counts
^{A,B} Means differ at *P <0.01* ^{a,b} , Means differ at *P <0.05*

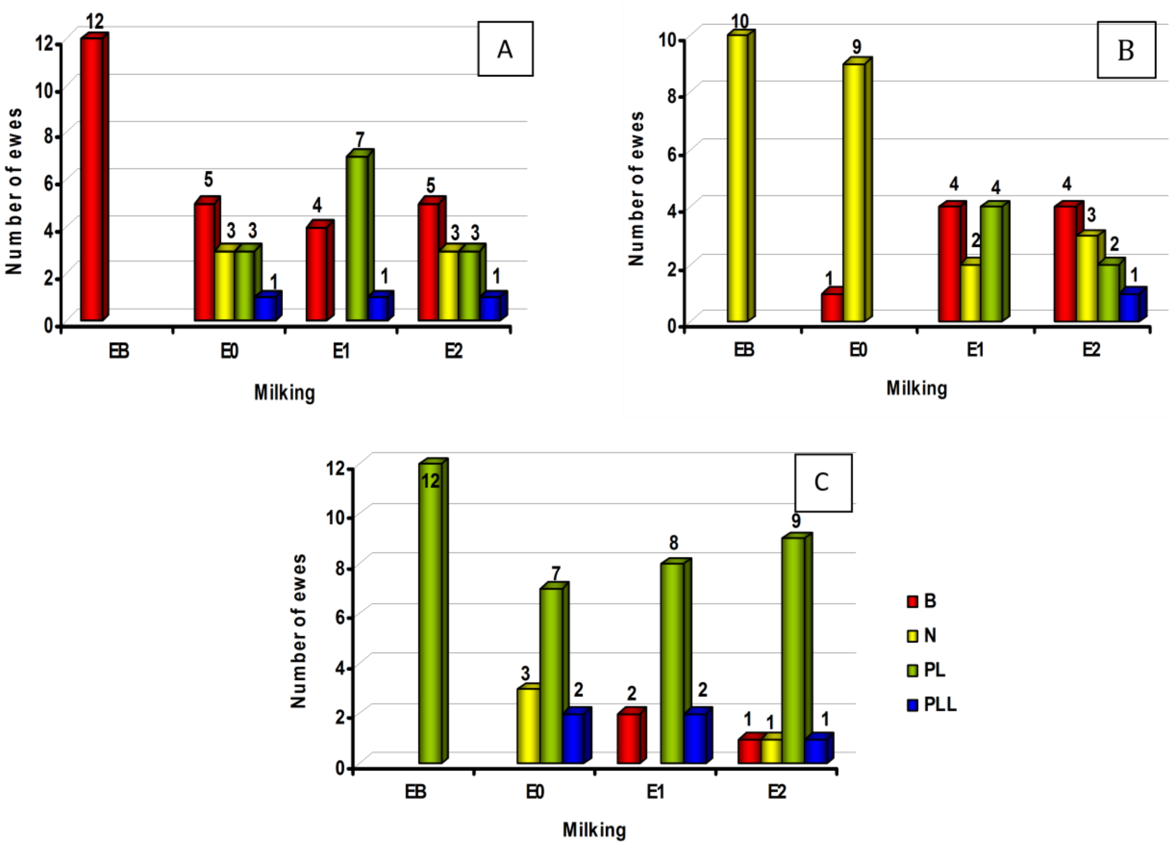

Figure 2A, B, C Frequency of distribution of milk flow types in groups differed by milk flow type during first experimental milking (EB) influenced by change of milking conditions and milking parlour (EO, E1, E2)

In milk composition, no significant differences were found between machine milkings for fat content, lactose content, dry matter and log SCC (Table 2). There was a significant increase of protein content in E1 and E2 compared to EB and increase of SNF in E2 compared to EB. In E0 we did not evaluate milk composition but when we take into account the fact that N milk flow types were high we could assume that percentage of fat content could be lower as compared with EB milking as reported **Antonič et al. (2013)**. The protein content is not influenced by milk distribution in the udder **(Tančin et al., 2007; Antonič et al., 2013)** though our aim was not to study nutrition effect the increasing protein level in milk after relocation could be ascribed to the intake of more protein nutrition (pasture, concentrate) as before relocation (corn silage, hay and concentrate). Feeding significantly influences the milk components in ewes **(Pulina et al., 2006)**.

CONCLUSION

The responses of ewes to stress from relocation and adaptation to other milking conditions were studied in ewes of Tsigai and Improved Valachian breed. Treatment significantly negatively influenced the milkability of ewes but a more clear response was found in ewes with bimodal milk flow response to machine milking before treatment. From obtained results the response of ewes was partially influenced by technical parameters of the milking machine. However ewes have soon adapted to other milking conditions.

REFERENCES

Antonič, J., Tančin, V., Uhrinčať, M., Mačuhová, L., Mačuhová, J., Jackuliaková, L. 2013. The effect of exogenous oxytocin on milkability and milk composition in ewes differed in milk flow pattern. *Small Ruminant Research*, vol. 113, no. 1, p. 254-257. http://dx.doi.org/10.1016/j.smallrumres.2013.03.011

Bruckmaier, R. M., Paul, G., Mayer, H., Schams, D. 1997. Machine milking of Ostfriesian and Lacaune dairy sheep: udder anatomy, milk ejection, and milking characteristics. *Journal of Dairy Research*, vol. 64, no. 2, p. 163-172. http://dx.doi.org/10.1017/S0022029997002173 PMid:9161910

Bruckmaier, R. M., Schams, D., Blum, J. W. 1993. Milk removal in familiar and unfamiliar surroundigs: concentrations of oxytocin, prolactin, cortisol and β-endorphin. *Journal of Dairy Research*, vol. 60, no. 4, p. 449-456. http://dx.doi.org/10.1017/S0022029900027813 PMid:8294603

Kulinová, K., Mačuhová, L., Uhrinčať, M., Tančin, V. 2012. The effect of stresfful treatment before and during milking on milkability of dairy ewes. *Veterinaria Ir Zootechnika*, vol. 57 (79), p. 39-43. [cit. 2012-04-05] Retrieved from the web: http://vetzoo.lva.lt/data/vols/2012/57/pdf/kulinova.pdf

Labussiére, J. 1988. Review of physiological and anatomical factors influencing the milking ability of ewes and the organization of milking. *Livestock Production Science*, vol. 18, no. 3-4, p. 253-274. http://dx.doi.org/10.1016/0301-6226(88)90035-8

Mačuhová, J., Tančin, V., Kraezl, W. D., Meyer, H. H., Bruckmaier, R. M. 2002. Inhibition of oxytocin release during repeated milking in unfamiliar surroundings: the importance of opioids and adrenal cortex sensitivity. *Journal of Dairy Research*, vol. 69, no. 1, p. 63-73. http://dx.doi.org/10.1017/S0022029901005222 PMid:12047111

Mačuhová, L., Tančin, V., Uhrinčať, M., Mačuhová, J. 2012. The level of udder emptying and milk flow stability in Tsigai, Improved Valachian, and Lacaune ewes during machine milking. *Czech Journal of Animal Science*, vol. 57, p. 240-247. [cit. 2012-05-07] Retrieved from the web: http://www.agriculturejournals.cz/publicFiles/64779.pdf

Mačuhová, L., Uhrinčať, M., Mačuhová, J., Margetín, M., Tančin, V. 2008. The first observation of milkability of the sheep breeds Tsigai, Improved Valachian and their crosses with Lacaune. *Czech Journal of Animal Science*, vol. 53, p. 528-536. [cit. 2008-12-15] Retrieved from the web: http://www.agriculturejournals.cz/publicFiles/02938.pdf

Marnet, P. G., Negrao, J. A., Labussiére, J. 1998. Oxytocin release and milk ejection parameters during milking of dairy ewes in and out of natural season of lactation. *Small Ruminant Research*, vol. 28, no. 2, p. 183-191. http://dx.doi.org/10.1016/S0921-4488(97)00075-8

Negrao, J. A., Marnet, P. G. 2003. Cortisol, adrenalin, noradrenalin and oxytocin release and milk yield during milkings in primiparous ewes. *Small Ruminant Research*, vol. 47, no. 1, p. 69-75. http://dx.doi.org/10.1016/S0921-4488(02)00247-X

Pulina, G., Nudda, A., Battacone, G. Cannas, A. 2006. Effects of nutrition on the contents of fat, protein, somatic cells, aromatic compounds, and undesirable substances in sheep milk. *Animal Feed Science and Technology*, vol. 131, no. 3, p. 255-291. http://dx.doi.org/10.1016/j.anifeedsci.2006.05.023

Rovai, M., Caja, G., Such, X., 2008. Evaluation of udder cisterns and effects on milk yield of dairy ewes. *Journal of Dairy Science*, vol. 91, no. 2, p. 4622-4629. http://dx.doi.org/10.3168/jds.2008-1298 PMid:19038938

Sevi, A., Taibi, L., Albenzio, M., Muscio, A., Dell`Aquila, S., Napolitano, F. 2001. Behavioral, adrenal, immune, and productive responses of lactating ewes to regrouping and relocation. *Journal of Animal Science*, vol. 79, no. 6, p. 1457-1465. PMid:11424682

Silanikove, N., Leitner, G., Merin, U., Prosser, C. G. 2010. Recent advances in exploiting goat's milk: Quality, safety and production aspects. *Small Ruminant Research*, vol. 89, no. 2, p. 110-124. http://dx.doi.org/10.1016/j.smallrumres.2009.12.033

Sinapis, E., Diamantopoulos, K.; Abas, Z.; Vlachos, I. 2006. Effect of vacuum level on milking efficiency, somatic cell counts (SCC) and teat end wall thickness in ewes of Greek mountain Boutsiko breed. *Livestock Science*, vol. 104, no. 1, p. 128-134. http://dx.doi.org/10.1016/j.livsci.2006.03.027

Sinapis, E., Hatziminaoglou, I., Marnet, P. G., Abaz, Z., Bolou, A. 2000. Influence of vacuum level, pulsation rate and pulsator ratio on machine milking efficiency in local Greek goats. *Livestock Production Science*, vol. 64, no. 2-3, p. 175-181. http://dx.doi.org/10.1016/S0301-6226(99)00151-7

Tančin, V., Bruckmaier, R. M. 2001. Factors affecting milk ejection and removal during milking and suckling of dairy cows. *Veterinary Medicine-Czech*, vol. 46, p. 108-118. [cit. 2002-02-12] Retrieved from the web: http://vri.cz/docs/vetmed/46-4-108.pdf

Tančin, V., Mačuhová, L., Oravcová, M., Uhrinčať, M., Kulinová, K., Roychoudhury, S. H., Marnet, P. G., 2011. Milkability assessment of Tsigai, Improved Valachian, Lacaune and F1Crossbred ewes (Tsigai x Lacaune, Improved Valachian x Lacaune) throughout lactation. *Small Ruminant Research*, vol. 97, no. 1, p. 28-34. http://dx.doi.org/10.1016/j.smallrumres.2011.01.007

Tančin, V., Uhrinčať, M., Kišac, P., Mihina, Š., Tančinová, D., Hanus, A., Brouček, J. 2004. The effect of relocation on milk removal in primiparous dairy cows reared in different rearing systems during early postnatal period. *Journal of Animal and Feed Science*, vol. 13, p. 93-100.

Tančin, V., Uhrinčať, M., Mačuhová, L., Bruckmaier, R. M. 2007. Effect of pre-stimulation on milk flow pattern and distribution of milk constituents at a quarter level. *Czech Journal of Animal Science.*, vol. 52, p. 117-121. [cit. 2007-04-20] Retrieved from the web: http://www.agriculturejournals.cz/publicFiles/00196.pdf

Acknowledgments:

Part of experiments of this study was funded by the Operational Programme for Research and Development project "MLIEKO No. 26220220098" of the European Regional Development Fund.

Contact address:
Lucia Jackuliaková, Slovak University of Agriculture in Nitra, Faculty of Agrobiology and Food Resources, Department of veterinary disciplines, Tr. A. Hlinku 2, 949 76 Nitra, Slovakia, E-mail: l.jackuliakova@gmail.com.

Vladimír Tančin, Slovak University of Agriculture in Nitra, Faculty of Agrobiology and Food Resources, Department of Veterinary Science, Tr. A. Hlinku 2, 949 76 Nitra, Slovakia; NAFC, Research Institute for Animal Production Nitra, Hlohovecká 2, 95141 Lužianky, Slovakia, E-mail: tancin@vuzv.sk, vladimir.tancin@uniag.sk

Michal Uhrinčať, NAFC, Research Institute for Animal Production Nitra, Hlohovecká 2, 95141 Lužianky, Slovakia, E-mail: uhrincat@vuzv.sk.

Lucia Mačuhová, NAFC, Research Institute for Animal Production Nitra, Hlohovecká 2, 95141 Lužianky, Slovakia, E-mail: macuhova@vuzv.sk

Ján Antonič, Slovak University of Agriculture in Nitra, Faculty of Biotechnology and Food Sciences, Department of Evaluation and Processing of Animal Products, Tr. A. Hlinku 2, 949 76 Nitra, Slovakia, E-mail: antonic@vuzv.sk

Marta Oravcová, NAFC, Research Institute for Animal Production Nitra, Hlohovecká 2, 95141 Lužianky, Slovakia, E-mail: oravcova@vuzv.sk.

Petr Sláma, Mendel University in Brno, Faculty of Agronomy, Department of Animal Morphology, Physiology and Genetics, Zemedelska 1, 613 00 Brno, Czech Republic, E-mail: petr.slama@mendelu.cz