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Short communication

The effect of exogenous oxytocin on milkability and milk composition in ewes differed in milk flow pattern

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ABSTRACT

During milking routine in sheep, the cluster is attached without pre-stimulation and milk ejection occurred (or not) as a consequence of liner movement on teat. The goal was to describe the importance of milk ejection before cluster attachment on milk flow patterns, milk composition and other parameters of milkability of ewes with two different physiological responses to usual milking (ewes with one emission of milk, i.e. expected no milk ejection (1P) and ewes with two emissions of milk i.e. expected milk ejection (2P)). On the base of three pre-experimental consecutive milkings, 22 adult lactating dairy ewes of two breeds Tsigaj ($n = 11$) and Improved Valachian ($n = 11$) were selected from the herd of experimental farm of APRC Nitra for this study. The animals were divided into two groups (first group 1P – ewes, and second group 2P – ewes). Ewes were regularly milked two times a day. Milk flow data were recorded during two evening milkings with 48 h in between. During the first measurement the half of the animals in each group was treated by 5 UI *i.m.* of oxytocin (OT) and the second half by physiological saline (SA) 60 s before the cluster attachment. The application of OT and SA in both groups was changed in cross-over design during the second evening milking. Milk flow kinetics were recorded individually using an electronic jar with 2-wire compact magnetostrictive level. The OT treatment caused shortening of the milking time, increasing of peak milk flow rate and milk yield in thirty seconds in both groups. There were not any changes in milk composition in 2P ewes between SA and OT treatment. In 1P ewes, there was significantly increased total milk yield, machine milk yield, peak flow rate, milk yield in thirty and in 60 s in OT treatment. Moreover, the increased fat yield was recorded in 1P group after OT treatment only. In conclusion, milk ejection occurrence before cluster attachment influences differently the milkability and milk composition in ewes differed in milk flow patterns during usual milking. Thus milk ejection is crucial in our breed for milk yield and composition recording.

1. Introduction

There are many farms in Slovakia where ewes are hand-milked, though the history of machine milking is dating back to the beginning of 1960s. However, the number of farms with machine milking or interest to milk the sheep with machine is increasing in the last decade.

The analysis of milk flow curves are used for monitoring of milk ejection occurrence during machine milking (Labussière, 1988; Bruckmaier et al., 1997; Džidić et al., 2004; Mačuhová et al., 2008) indicating a positive physiological response of ewes, i.e. OT release, to machine stimuli.

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Few types of milk flow were characterized in ewes. First type (1P, one emission) represents milk flow curves with one peak of milk flow before stripping when no OT release is expected in response to milking. Second type (2P, two emissions) represents milk flow with two clearly separated milk flow peaks when endogenous OT is released. With increasing milk production, the milk ejection can occur before removal of cisternal milk and thus the second peak of milk flow is masked, i.e. plateau milk flow (PL) (Marnet et al., 1998). Also larger volume of cistern and higher production could be a reason of PL due to the limitation of teat canal even if OT is not released during milking. Recently, it was found out that the volume of residual milk of ewes with PL was higher than in 2P, suggesting that not all ewes with PL released OT or milk ejection occurred during milking (Mačuhová et al., 2012).

In dairy practice, there is not performed any teat stimulation before the cluster is attached to the teat as it is common in dairy cows (Tančin et al., 2007). Thus the parameters of milkability, especially milk flow kinetic, depend on the physiological response of ewes to machine stimulation. There were reductions of 2P milk flow curves occurrence after pre-stimulation (Bruckmaier et al., 1997). Pre-stimulation causing OT release before the cluster is attached to the teat could significantly change the parameters of milkability as it was recently found out with administration of exogenous OT (Antonič et al., 2013). However, we did not test the response of ewes with different milk flow kinetic during usual milking to exogenous OT in that study.

Milk distribution in the udder of ewes differs from that of a cow. In ewes, large amount of milk is stored in the cistern that is available for mechanical removal only. However, the amount of milk stored in alveoli is important for milk production and fat yield as well. Normally, machine milking causes an OT release via a neuroendocrine reflex and milk ejection. Moreover, OT release is very important to stimulate milk secretion through alveoli emptying (Zamiri et al., 2001; Silanikove et al., 2010). However, machine milking could sometimes be associated with some kind of stress causing significant reduction of milk yield as a consequence of inhibition of OT release causing 1P flow (Bruckmaier et al., 1997; Negrão and Marnet, 2003) in ewes. The important role affecting OT release is adaptation of different breeds to machine stimulation. Tsigai and Improved Valachian have been shown to have relatively high percentage of 1P and 2P milk flow patterns (Mačuhová et al., 2008; Tančin et al., 2011; Kulinová et al., 2012). Therefore, to evaluate the milkability and milk composition of above mentioned breeds during milk recording, the milk flow patterns could be taken into account.

The hypothesis was that pre-stimulation (simulated by administration of exogenous OT injection) before cluster attachment will differently influence milkability and milk composition in ewes differed in milk flow pattern (1P versus 2P) during usual milking. The goals of our investigation were to evaluate the importance of milk ejection before cluster attachment on milk flow patterns, milk composition and other parameters of milkability related to physiological response of ewes to usual milking (1P and 2P response).

2. Materials and methods

2.1. Animals and milking management

Twenty-two adult lactating dairy ewes of 2 breeds Tsigai (TS, $n = 11$) and Improved Valachian (IV, $n = 11$) with healthy udders (on the base of visual control of mammary gland and sensory evaluation of milk) from the experimental farm of the Animal Production Research Centre in Nitra, Slovakia, were selected from the flock of 400 ewes. Ewes were selected on the basis of milk flow pattern from three consecutive previous milkings before the experiment started. They were on their 3rd–8th lactation and had similar stage of lactation (100 ± 15 days in milking). 11 ewes with 1P type (1P group: 5 TS and 6 IV ewes) and 11 ewes with 2P type (2P group: 6 TS and 5 IV ewes) of milk flow were selected for the experiment. Ewes were milked routinely twice daily at 8:00 and 20:00 h with machine stripping. Machine milking took place in a 1×24 low-line side-by-side milking parlour with 12 milking units by one milking technician. The milking machine was set to provide 160 pulsations per minute in a 50:50 ratio with a vacuum level of 39 kPa. During each milking the ewes received 0.1 kg per head concentrate in parlour.

2.2. Experimental procedure

Experimental milkings were performed during 2 evening milkings with one evening milking in between without any treatment and milk flow recording to recover the alveolar milk volume in OT treated animals. During the first measurement, half of the animals of each group were *i.m.* injected with 5 IU of oxytocin (OT treatment) and the second half with physiological saline (SA treatment) 90 s before the cluster attachment. The application of OT and SA in both groups was changed in cross-over design during the second evening milking.

2.3. Samples collection and analysis

Milk flow kinetics were recorded individually using an electronic jar that continuously collected the milk during milking. Within the jar there was a 2-wire compact magnetostrictive level transmitter (NIVOTRACK, NIVELCO Ipari Elektronika Rt, Budapest, Hungary) connected to a computer. The milk level in the jar was continuously measured by a transmitter that recorded the signals on a computer once per second. The registered data were processed with Microsoft Excel®. Milk flow curves were evaluated according to Bruckmaier et al. (1997), Rovai et al. (2002) and Mačuhová et al. (2008) into 3 types (1peak (1P), 2peaks (2P), plateau (PL)) to select the animals with 1P and 2P milk flow types as well as to record the change in response to OT treatment.

The milk flow pattern was calculated using a formula by Mačuhová et al. (2007):

$$\text{Milk flow rate}\,(\text{L min}^{-1}) = (L_n - L_{n-4}) \times 15, \quad L - \text{milk yield in liters},$$
$$n - \text{time in s}, \quad n > 3\,\text{s}.$$

From the measured parameters the following data were evaluated: total milk yield (TMY, L), machine milk yield (MMY, L), stripped milk yield (SMY, L), stripped milk yield (SMY, %), milking time (MT, s), peak flow rate (PFR, L min^{-1}), time to peak flow rate (TPFR, s), milk yield in 30 s (MY30S, L), milk yield in 60 s (MY60S, L).

After each milking, the individual milk samples were collected from the jar for composition analysis. The milk composition was analyzed for percentage of fat, protein, lactose, total solids and solids-not-fat with MilkoScan FT120 (Foss, Hillerød, Denmark). Somatic cells count (SCC) was analyzed with Somacount 150 (Bentley Instruments, Inc., Chaska, Minnesota) analyzer.

Fat yield was calculated by using formula:

$$\text{Fat}\,[\text{g}] = \frac{\text{TMY}\,[\text{L}] \times \rho \times \text{fat}\,[\%]}{100}; \quad \rho = 1038\,\text{kg m}^{-3}$$

2.4. Statistical analysis

Totally 42 milk flow curves and 42 milk samples from 21 ewes were evaluated and analyzed by Statistica programme (version 8.0, StatSoft. Inc.). One ewe from OT treatment was removed from statistical evaluation due to no milk flow during milking. *T*-test of dependent samples was used for comparison of milkability parameters and milk composition between