Effect of calf stimulation on milk ejection in reindeer *(Rangifer tarandus)*

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Abstract: The objective of this study was to establish methods for stimulating the milk ejection in reindeer kept for milking purpose. Calves were used to stimulate milk does' let down. In experiment 1, five does were allowed olfactory, acoustic and visual contact with their calves during milking, whereas four does were milked in isolation. The treatment of the groups was alternated every day during the eight days experiment. Olfactory, acoustic and visual contact with the calf did not influence the doe's milk yield. The milk yield varied significantly between individual females within treatment ($P < 0.01$). In experiment 2, the calves were allowed to suckle their mother for a short period (two seconds) prior to milking being initiated. The same alternate design as in experiment 1 with groups consisting of three and two animals respectively was used, and the experiment lasted four days. The pre-suckling stimulation significantly increased the milk ejection measured as milk yield ($P < 0.05$), and the residual milk after the treatment was negectible. Moreover, the milk ejection varied between individual females within treatment ($P < 0.05$). We conclude that it is possible to achieve a complete milk removal by machine milking after the does have been pre-stimulated by suckling of calves. Olfactory, acoustic and visual contact with calves during milking failed to influence the milk ejection in this study. However, the results have to be interpreted with caution due to limited sample size.

Key words: lactation, let down mechanism, milking, oxytocin, suckling.

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Introduction

Recent interest for developing dairy farming as a niche production in reindeer (*Rangifer tarandus*) husbandry (Holand *et al.,* 2002a), has motivated experimental work on lactation physiology. To achieve efficient milk ejection is a recurrent problem when machine milking of reindeer does is to be performed (Holand *et al.,* 2002b). The importance of the milk ejection for milk yield is well documented among traditional dairy animals (Bruckmaier, 2001; Marnet & Mckusick, 2001). Milk ejection is regulated through a neuro-endocrine reflex elicited by tactile teat stimulation, which causes release of oxytocin from the posterior pituitary. The myoepithelial cells, surrounding the alveoli, contract in response to oxytocin and the alveolar milk is transported through the milk duct system into the mammary gland and teat cisterns (Larson, 1985).

Various stressors like aversive handling, novel environment and emotional stress will inhibit or suppress milk ejection in domestic animals (Wellnitz & Bruckmaier, 2001). This may be even more pronounced in semi-domesticated species as reindeer. In primiparous cows manual stimulation may fail to induce milk ejection (Bruckmaier *et al*., 1992). Furthermore, Black (1984) reported poor milk ejection in *Bos indicus* when the calf was absent. A high proportion of residual milk in reindeer suggests that the traditional stimulation method of washing and massaging of the udder is inadequate for milk let down (Holand *et al.,* 2002b). In dairy cows the stimuli that induce the let down reflex are ranked by Schmidt (1971) in the following order of ascending importance: (1) showing the calf to its mother (2) washing the udder (3) combined washing with showing calf to the mother (4) suckling of the calf.

In the present paper, we report the effect of the following two stimuli on the milk ejection in reindeer does: 1) Milking while the does had olfactory-, audio- and visual contact with their calves, but no suckling or physical contact, 2) Milking after stimulation of does by a suckling event prior to milking.

Methods

Experimental design

Nine semi-domestic reindeer of the experimental herd at the department of Animal Science, Agricultural University of Norway were used. The animals were kept in a 0.4 ha enclosure and fed concentrate (Formel Favour 20, Felleskjøpet) and hay *ad lib.* The animals had no prior experience to machine milking. The first three weeks *post-partum* does and calves were kept together for free suckling, and after this a period of adaptation to machine milking was initiated. Milking was performed once a day at 15:00 PM. Calves were separated from the does from 09:00 AM and until milking was completed at 16:00 PM. After milking and until the following morning calves were left together to suckling. The milking equipment used was a specifically designed cluster with teat cups fitted to the reindeer udder, developed by S.A. Christensen & Co (SAC, Denmark). Pulsation ratio, pulsation rate and vacuum level was set at 60:40, 100 pulsations per minute and 28 kPa, respectively. After a month of machine milking once a day, two experiments were performed to investigate the effect of calf stimulation on milk let down.

Experiment 1: Five does were milked with their calf present providing olfactory, acoustic and visual contact with their calves, whereas 4 does was milked without the being calves present (*i.e.* the control). The does had no physical contact with their calves and were separated by a gate with bars during milking. The calves were separated from the does for six hours before milking. Does were prepared for milking by first washing the teats and udder with a wet paper towel and then drawing two squirts of milk from each udder quarter. The preparation lasted for approximately one minute. After each milking the volume of machine milk was registrated. The treatment of the two groups was alternated every day and the experiment lasted for eight days.

Experiment 2: The treatment consisted of letting the calves suckle their mothers for a short period (two seconds) before the milking was initiated without further pre-stimulation. The delay from the suckling was abrupted and to onset of the clusters was approximately 1 minute. Alternatively, milking was initiated without pre-suckling (*i.e.* control). The control group was stimulated by washing the udder as in experiment 1. The same reverse design as in experiment 1 was used, with groups consisting of three and two animals and an experimental period of four days. In this experiment the residual milk was measured, by an additional milking after i.m. injection of 10 IU of oxytocin, in addition to the machine milk.

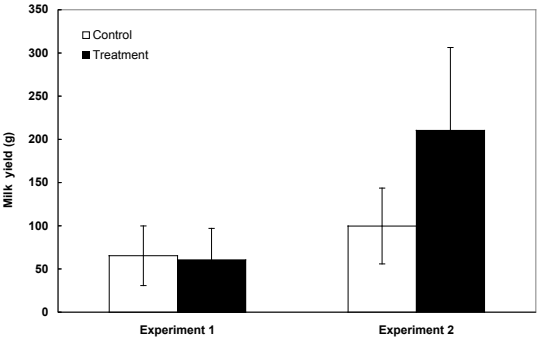

Fig. 1. Average milk (g) yield of reindeer does after six hours separation from their calves. In experiment 1 does had olfactory, acoustic and visual contact with their calves during milking. In experiment 2 does were stimulated by a short suckle event (two seconds) with the calves prior to milking. Individual variation is shown as standard deviation.

Statistical analysis

We used linear mixed models to test the effects of treatment (entered as categorical variable) on the milk yield in both experiments (*i.e.* experiment 1: olfactory, acoustic and visual contact with calf as stimulus versus control; and experiment 2: pre-suckling by own calf as a stimulus versus control). Because of repeated measurements on individual females within each treatment, we entered female identity within treatment as a random variable in the models. All analyses were performed using SAS (1989).

Results

In experiment 1, no treatment effect was recorded *i.e.* the amount of milk collected from the does was not significantly related to whether the doe had an olfactory, acoustic and visual contact with the calf during milking or not ($F=0.78$, d.f.=16, $P=0.78$; Fig 1). The variance component of our random term was significant ($P=0.007$), meaning that we have an individual effect. In experiment 2, a treatment effect was recorded, *i.e.* pre-suckling stimulus significantly affected the milk let down ($F=5.49$, d.f.=8, $P=0.047$; Fig. 1). The variance component of the random term was significant ($P=0.04$). The proportion of machine milk relative to total milk produced (machine and residual milk added) was 92.5% after treatment with suckling, whereas the proportion of machine milk in the control group was 42.6% (*i.e.* the proportion of residual milk in the control group was 57.4%).

Discussion

The presence of calves during milking did not affect the milk ejection among the experimental animals, as the milk yield was the same as when the does were milked without their calves present. Contact with the calf combined with washing udder is reported as a strong stimulus for let down in dairy cows (Schmidt, 1971) and in tropical countries using *B. indicus* genotypes the presence of calf at milking has a major impact on the milk yield and is necessary for milk ejection to occur (Alvarez *et al.,* 1980). Presence of calf during hand-milking of moose (*Alces alces*) has been practised in Russia, although only during the initial phase where the animals were being trained for milking (Arman, 1979).

The lack of effect of the calf presence stimulus in our experiment can be related to several factors. The olfactory, acoustic and visual contact with the calf may simply not be a strong enough stimulus to induce milk ejection. Furthermore, having the calf present at milking is a novel situation for the does and might, due to the relatively short experimental period, fail to affect the milk let down. The does did not have the opportunity to come in physical contact with the calves, as a gate with bars separated them. Although the does appeared undisturbed during milking, the calves were making contact sounds and attempted to enter the milking parlour. This may have led to emotional stress in the does. If the does are stressed because they are able to see and hear the calf, without opportunity of physical contact, the calf presence may fail to have an effect on the let down mechanism since emotional stress is known to inhibit the ejection reflex (Tancin *et al*., 2001).

The poor milk let down in presence of calf in a partly suckling system may also be due to a psychological disturbance as pointed out by Bar-Peled *et al*. (1995). It has been suggested that cows, both suckled and milked, voluntarily suppressed milk ejection during milking in order to ensure milk for the calf. (Bar-Peled *et al*., 1995; Tancin *et al*,. 2001). Poor milk let down due to machine milking in restricted suckling systems is also reported by Krohn (2001). Suppressed milk ejection to ensure milk for the calf may be a particularly relevant theory in reindeer since their history, as a modern dairy production animal is short, and the maternal instincts are still completely intact.

Suckling before milking affected the milk ejection among the experimental animals. A two second suckling event was sufficient to induce the milk ejection and enabled a complete emptying of the udder. The suckling behaviour in reindeer is characterized by frequent suckles of short duration (White & Luick, 1984), which requires a rapid milk ejection. Hence, the time lag from the suckling was abrupted and until milking started was probably of sufficient length for the alveolar milk to be transported into the cistern. Suckling ought to be the most efficient stimulation for milk ejection since this is the natural way of stimulating the teats (Uvnäs- Moberg *et al*., 2001). The superior effect of suckling on oxytocin-release and milk ejection is documented in dairy cows (Bar-Peled *et al*., 1995; Lupoli *et al*., 2001). Current results are in agreement with Orihuela (1989) who found that in Zebu-type cattle, suckling induced milk let down and gave the highest milk yield whereas milking with physical contact without suckling resulted in an intermediate milk yield. Milking when the cow only had visual, acoustic and olfactory contact with the calf gave the lowest milk yield (Orihuela, 1989). Additionally, our results shows that the stimulation by the pulsating lines during machine milking is not adequate to evoke milk ejection.

The complete milk removal after milk let down induced by suckling, indicates that the does are not stressed during milking and that given an adequate stimulus it is possible to completely empty all the mammary glands, without exogenous oxytocin administration. However, our results have to be interpreted with caution due to limited sample size.

From a practical point of view there are challenges connected to the method, as some does did not allowed the calf to suckle when left alone together with human presence. This is probably a question of adaptation. The relatively small udder in reindeer compared to other ungulates makes it necessary to develop a milking regime that secure complete emptying of the udder at adequate intervals and suggests partly suckling of calves as a viable strategy for keeping up the milk production (Holand *et al*., 2002b). The use of calf suckling as a let down stimulus should be possible to combine with milk production in system where the doe has her calf at foot. Moreover it would be necessary to develop a system based on both milking and suckling to maintain the social bonding between calves and does to achieve the effect of calf suckling as a let down stimulus.

Conclusions

It is possible to achieve complete milk removal during machine milking without exogenous oxytocin administration in reindeer does by a short suckling stimulus, prior to milking to induce the ejection reflex.

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Abstract in Norwegian / Sammendrag:

Formålet med dette forsøket var å prøve ut ulike metoder for å stimulere nedgivninga av melk hos rein. Kalvene ble tatt i bruk for å stimulere nedgivninga. I forsøk 1 hadde simla lyd-, lukt og synskontakt med kalven mens melkingen pågikk. Vi benyttet et "switch back design" der fem simler hadde kontakt med kalven under melkingen og fire ble melket uten kontakt. Behandlingen ble byttet om annenhver dag i de åtte dagene forsøket varte. Lyd-, lukt og synskontakt med kalven under melking hadde ingen innvirkning på melkemengden ved maskinmelking. Det var imidlertid individuell variasjon i hvor mye melk man oppnådde hos simlene ($P < 0.01$). I forsøk 2 lot vi kalvene suge simlene en kort stund før simlene ble melket. Kalven ble sluppet inn til simla og sugingen ble avbrutt etter to sekunder. Deretter ble simla ført inn for maskinmelking. Forsøket varte i fire dager og vi benyttet samme "switch back design" som i forsøk 1, med grupper bestående av henholdsvis to og tre dyr. Stimuleringa med suging hadde en signifikant innvirkning på nedgivninga. ($P < 0.05$), og mengden gjenværende melk var minimal. Dessuten var det en signifikant individuell variasjon i melkemengden innen behandlingen ($P < 0.05$). Vi konkluderer med at det er mulig å oppnå en fullstendig tømming av juret ved maskinmelking dersom simlene først er blitt stimulert med suging av kalven. Lyd-, lukt- og synskontakt med kalven under melking hadde ingen innvirkning på nedgivninga av melk i dette forsøket. Resultatene må imidlertid tolkes med varsomhet siden det statistiske utvalget er begrenset.