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Reduced locomotor play behaviour of dairy calves following separation from the mother reflects their response to reduced energy intake

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ABSTRACT

Play behaviour is an indicator of good welfare in young calves and is reduced by low energy intake and weaning off milk. There is renewed interest in keeping calves longer with the cow but separation leads to signs of distress, such as vocalizations. Providing calves with an alternative milk source prior to separation helps them adapt to the separation. We hypothesized that (1) locomotor play of nursed calves separated from their mothers will reflect their energy intake after separation, and (2) calves' prior access to automated milk feeders will increase locomotor play and reduce vocalizations after separation due to an increased energy intake. 30 Holstein cows and their calves were kept in adjacent pens. "Suckling-only" calves were allowed to suckle the cow during the night and received no other milk, "Milk-feeder only" calves could obtain 12 L/day milk only from an automated milk feeder while "Suckling-and-milk-feeder" calves could suckle during the night and were allowed 12 L/day of milk from an automated milk feeder. At 6 weeks of age, calves were not allowed to enter the cow pen during the night but had access to automated milk and grain feeders. To measure locomotor play, we placed the calves individually in a 9.5 m × 2 m arena for 10 min, 10 times before and after separation. The frequency of jumping and vocalization were scored. Digestible energy (DE) intakes of the calves after separation were calculated from combined milk and grain intake. Before separation, there were no differences between the treatment groups on any behavioural measure ($P > 0.10$). For Suckling-only calves, there was a marked decrease in the frequency of jumping (Wilcoxon test, $P = 0.02$) and a marked increase in the frequency of vocalization during the first 3 days after separation ($P = 0.004$). During the first 3 days of separation, Suckling-only calves had a lower frequency of jumping (Mann–Whitney test, $P = 0.009$) and vocalized more frequently (Mann–Whitney test, $P = 0.009$) than did calves of the other treatment groups. For all calves, the number of vocalization was negatively correlated with frequency of jumping ($r_s = -0.51$; $P = 0.005$). After separation, Suckling-only calves had lower energy intakes than calves of the other treatment groups (Mann–Whitney test, $P = 0.01$) and the digestible energy intake of the calves was positively correlated with the frequency of jumping ($r_s = 0.75$; $P < 0.001$), and negatively correlated with the frequency of vocalization ($r_s = -0.59$; $P < 0.001$). There were no differences between treatment groups five or more days after separation. Our results show that a low energy intake of calves after separation from the mothers is associated with reduced locomotor play and increased vocalization and that prior access to an automated milk feeder helps maintain energy intake after separation, which results in increased locomotor play. The association between vocalization and locomotor play suggests that the reduction in play at separation may be related to the emotional response of the calves to the decrease in energy intake.

1. Introduction

There is widespread interest in using play behaviour as an indicator of good welfare in captive animals (Boissy et al., 2007; Held and Špinka, 2011). Young calves show a variety of locomotor play

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behaviours, mainly running with jumping, kicking and bucking (Jensen et al., 1998; Jensen and Khyn, 2000), and this behaviour has been shown to be reduced by challenges to welfare such as a low energy intake and weaning off milk (Duve et al., 2012; Krachun et al., 2010; Rushen and de Passillé, 2012). Calves show many other behaviours when weaned off milk, such as a high incidence of vocalization (Jasper et al., 2008; Thomas et al., 2001), which have been interpreted as a sign of distress and hunger (Weary et al., 2008), and which are associated with a negative cognitive bias (Daros et al., 2014). However, the relationship between vocalization, energy intake and locomotor play have not been fully investigated.

Separation of the young calf from its mother soon after birth has been a corner stone of the dairy industry in industrialized countries, but this is a contentious issue for the public (Ventura et al., 2013) and there is renewed interest in prolonging the period that the calf is kept with the cow (Fröberg et al., 2008; von Keyserlingk and Weary, 2007; Wagner et al., 2012), especially in organic dairy production (Wagenaar and Langhout, 2007). Keeping the calf with the cow can increase play behaviour by the calf (Valníčková et al., 2015). When the calf is kept with the cow for a few days or weeks, and then removed, the animals frequently vocalize (Flower and Weary, 2001; Marchant-Forde et al., 2002; Johnsen et al., 2015c). This has been interpreted as a sign of distress resulting from a breaking of the emotional bond between the calf and the cow, but it may also reflect the loss of the main source of nutrients for the calf (Thomas et al., 2001). Thomas et al. (2001) showed that keeping the calf satiated after separation by frequently providing milk from a teat bottle reduced the vocal response to separation. Providing calves with an alternative milk source and training them to use this source prior to separation from the mother can help them achieve nutritional independence from the dam before separation, thus separating in time the effects of weaning off milk and separation from the mother (Johnsen et al., 2015a).

Locomotor play by young dairy calves occurs in only a short period of time, but the locomotor play that occurs when calves are placed for a brief period of time in a large enclosure is moderately correlated with the amount of locomotor play in the home pen (Mintline et al., 2012). In such situations, calves often also vocalize, which may reflect their fearfulness in response either to novelty or social separation (de Passillé et al., 1995), and calves showing the most signs of fear show the lowest levels of locomotor play (Rushen and de Passillé, 2014).

In this study, we kept calves with their mothers and either allowed them to suckle or prevented them from doing so but offering them 12 L/day of milk from an automated feeder. We hypothesized that the amount of locomotor play calves show after separation from the cow would reflect their energy intake, and that having prior access to the feeders would increase the amount of play that occurred when calves were separated from the cows. We also hypothesized that the calves that vocalized the most after separation would show the lowest amounts of locomotor play.

2. Methods

The experiment took place at the University of British Columbia's Dairy Education and Research Centre in Agassiz, BC, Canada. All procedures were approved by the Institutional Animal Care Committee following the guidelines of the Canadian Council for Animal Care.

2.1. Animals and housing

We used 30 Holstein calves (three heifers and 27 bulls; mean ± SD birth weight = 44.8 kg ± 4.2 kg) born in a straw-bedded, individual calving pen. Within 6 h of parturition, each calf was bottle fed 4 L of good quality colostrum.

Each calf was kept in the calving pen with its dam for between 27 h and 88 h after parturition. After this time, the cows and calves were moved to a group pen with 24 free-stalls. During the nighttime (20:00–08:00 h) the calves and cows were kept together in the group pen. During daytime (08:00–20:00 h) the calves were kept separated from the cows in a 17.3 m × 3.2 m sawdust-bedded pen, adjacent to the cow pen, and separated by a railing of galvanized steel, which prevented nursing but permitted some physical contact between the cows and calves. The cow/calf pairs were managed as a single dynamic group, with additional cow/calf pairs being added continuously as parturition occurred.

2.2. Experimental treatments

At calving, the cow/calf pairs were allocated to three treatments. (1) "Suckling-only" calves were allowed to suckle the cow during the night and received no other milk, (2) "Milk-feeder-only" calves were prevented from suckling their mothers and were only allowed milk from an automated feeder (described below), (3) "Suckling-and-milk-feeder" calves were allowed milk from an automated feeder and could suckle from their dam during the night. These are described in more detail by Johnsen et al. (2015a,b). We used a randomized block design. As the calves were born, the cow/calf pairs were allocated as triplets with one pair to each treatment, ensuring that each treatment included one female calf. Due to problems with the equipment, one cow/calf pair had to be excluded, resulting in only 9 Suckling-and-milk-feeder calves.

We collected data from the calves during three periods. For the first 6 weeks (Baseline period), calves were housed in the calf pen during the day (approximately 08:00–20:00 h), and all calves were allowed to enter the cow pen during the night (approximately 20:00–08:00 h). The cows of the Milk-feeder-only calves had a net made of hessian sacking placed over the udder and attached to the cow with straps in order to prevent suckling (model Nr. 87355301, DeLaval, Tumba, Sweden). In the calf pen, Milk-feeder-only calves and Suckling-and-milk-feeder calves had constant access to 12 L/day of pasteurized waste milk from the UBC dairy herd (3.97% fat, 4.10% protein, 3.30% lactose) supplied by automated feeders (CF 1000CS Combi, DeLaval Inc., Tumba, Sweden). The feeders were programmed to prevent the Suckling-only calves from obtaining milk from the feeders. Calves of all treatments had ad libitum access to calf grain-based starter (20.4% crude protein on a dry matter basis, Unifeed Ltd., Chilliwack, Canada), supplied by an automatic feeder controlled by the same computer as the milk feeder. These feeders recorded the daily milk and starter intake for each calf.

After all three calves in a triplet reached 6 weeks of age, they were moved to a second calf pen (7.2 m × 3.2 m), which was next to the first calf pen, and which still permitted visual, auditory and some tactile contact with the dam, but prevented nursing. However, the calves were from then on not allowed to enter the cow pen during the night. In the calf pen, all calves were allowed up to 12 L/day of milk from the automated feeder, but no training was provided to the Suckling-only calves. The calves remained in the pen next to their mothers for 4 days (Partial Separation period-PS) after which the mothers were moved to another free-stall pen where they had no physical contact with their calf (Total separation period—TS). Triplets of calves were continuously added to the group.

2.3. Behavioural test

To measure the calves' locomotor play, we placed the calves individually in an open arena for 10 min. (Mintline et al., 2012).