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Is rearing calves with the dam a feasible option for dairy farms?—Current and future research

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ABSTRACT

In the dairy industry it is common practice to separate cow and calf shortly after birth but this practice is disputed because of animal welfare concerns. Some producers, in many countries, milk cows that also nurse dairy calves. These cow–calf systems allow nursing as well as affiliative and other natural behaviours. In this review paper we describe cow–calf systems used in practice and/or in research, discuss the benefits and challenges documented by research, and identify areas where more research is needed. Four cow–calf systems are described: (1) free contact systems where cow and calf have unrestricted access to each other; (2) restricted suckling systems allowing short daily contact only to nurse; (3) half day contact where cow and calf are housed together during the day or night; and (4) foster cow systems where one cow nurses 2–4 calves usually without milking. In free and half day cow–calf contact systems the calf drinks large amounts of milk and has high daily weight gains. High pre-weaning calf weight gains have been shown to lead to higher milk yield during that animal's first lactation. One issue with cow–calf systems is the depressed weight gain of calves at weaning. The premature separation of cow and calf, compared to the natural situation, may cause stress especially in free contact systems. Weaning and separation should therefore occur in two steps. Half day contact seems particularly promising because animals get used to being separated, they experience positive human handling, and calves can learn to use a milk feeder which will prevent the growth check following weaning. Nursing cows yield less saleable milk during the suckling period, can have problems with milk ejection during machine milking and have a lower fat content of the milk, compared to non-nursing cows. Udder health of the cow may be positively affected by nursing. A rich social rearing environment has recently been shown to improve cognitive skills of calves. Still, studies on long term effects of dam rearing on behaviour, health, production and farm economics are few. There is also a need to address ways to control transmissible diseases when dairy cattle are kept in mixed age groups. Increased knowledge will help us design functional high tech dairy management systems that respect the natural behaviour of cows and calves during the calf rearing period.

1. Introduction

On most dairy farms, the calf is routinely separated from the dam shortly after birth. This practice deprives dairy cows and calves of forming bonds and profiting from natural interactions, and is criticized from an animal welfare point of view (e.g., von Keyserlingk and Weary, 2007). However, calves are hiders and this may be why the practice of separating calves and cows at birth has been successful. The cow seeks isolation from the herd before parturition, and the calf is left alone and hides while the dam is foraging (Kilgour and Dalton, 1984; Vitale et al., 1986; Langbein and Raasch, 2000). When the cow returns to the herd with her calf, the calf seeks the company of other calves, and from approximately the age of two weeks calves spend much time in "kinder-garden" groups (e.g., Reinhardt et al., 1977; Kiley-Worthington and de la Plain, 1983; Vitale et al., 1986).

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Over the past decade, a number of studies have explored different ways of keeping cows and calves together and examined possible benefits of this more natural rearing system, including the expression of natural behaviours. In many cow–calf systems, calves can choose the frequency of meals and meal sizes that fit their physiological needs. Studies looking at calf growth highlight the large discrepancy between the low amount of milk usually fed to calves on farms and the large amount the calves will drink when allowed to suckle freely from their dam (Grøndahl et al., 2007; Khan et al., 2011). There is a growing body of evidence that early high milk intake leads to higher milk production in the heifers' first lactation (Shamay et al., 2005). All these results support the view that leaving cow and calf together before weaning can improve calf welfare and also give some production benefits. However, high milk intakes by calves can be achieved without dam rearing, and there are challenges with dam rearing systems which need to be addressed.

This review and discussion paper is inspired by the satellite workshop "Dam rearing in dairy production" during the annual meeting of the International Society for Applied Ethology (ISAE) 2014. Workshop participants described and discussed cow–calf systems, production traits of the suckled cow and effects on calf development as well as productivity when becoming a dairy cow.

In the current paper we present and discuss the advantages and disadvantages of the different cow–calf systems as well as further research opportunities in this area. We examine welfare and productivity aspects (milk yield, milk composition and growth), including long-term effects for the cow and calf, as well as practical challenges such as labour inputs and problems with milk let down at milking. We also explore novel advantages, recently demonstrated, such as the flexible learning capacity of calves when raised in complex social environments as compared to calves raised in a conventional individual housing system (Costa et al., 2014; Gaillard et al., 2014; Meagher et al., 2014). We describe ways of managing cow–calf rearing that may be attractive to producers as well as the public. Finally we discuss how studies of dam rearing of dairy calves have permitted scientists to study and better understand the physiology, behaviour and performance of calves and cows from a different angle. These findings and approaches are clearly opening the way to a different look at how to improve cow and calf welfare on dairy farms.

There are differences between dam rearing in *Bos taurus* and *Bos indicus* which at some points are mentioned but the focus of this paper is high yielding *B. taurus* dairy cows.

2. Dairy cow–calf systems

The design elements of the different dairy cow–calf systems originate to a large extent from practical developments and the experience of farmers who keep cows and calves together. In Norway and Sweden, respectively, 18% and 22% of the organic dairy farmers let the calves suckle beyond the mandatory 3 days (now 1 day for Sweden), mostly for one week, but some for an extended period up to the age of 13 weeks (Ellingsen et al., 2015). In this section, we will review and describe the effects of the different suckling systems on cow–calf bonding, on responses of cows and calves to separation and weaning as well as on calf growth. Advantages and disadvantages of the different systems regarding behaviour and calf performance, as compared to conventional rearing, are given in Table 1.

2.1. Free cow–calf contact

Free contact systems imply that the cow and her calf are kept together 24 h/d for an extended period of time (mostly 6 to 12 weeks) during which the cow is milked, usually twice daily. Consequently cow and calf are free to interact and can nurse at any time. This system has been implemented in different cow management systems: cubicle housing with an automatic milking system (Fröberg and Lidfors, 2009); cubicle housing with milking parlour where a selection gate permits calves' exclusive access to a separate calf creep area (Roth et al., 2009; Fröberg et al., 2011; Wagner et al., 2013), and lastly deep litter straw yard system with a concrete loafing area and a separate calf creep area (Johnsen et al., 2015c; Zipp et al., 2015).

Benefits of the free contact system for the calf include high weight gains and contact with the dam as well as other cows and calves (Table 1). The weight gain of free suckling calves is higher than that of calves reared without the dam in the conventional limit milk feeding system (usually a milk allowance of 10–13% of body weight per day). In fact, average daily weight gains of 0.9 kg to 1.4 kg during the first months are reported for calves suckling their dam (Grøndahl et al., 2007; Roth et al., 2009).

Care-taking behaviours by the dam, nursing, and cow–calf bonding which include affiliative behaviours such as licking, rubbing and staying close are important natural behaviours of cattle (Wagenaar and Langhout, 2007) and are all performed in a free contact system. Calves in free-contact systems show less abnormal behaviours such as tongue-rolling and cross-sucking during the pre-weaning period compared to calves reared without the dam and fed conventional restricted amounts of milk (Table 1). Cross-sucking refers to the behaviour of a calf sucking ears, navel or scrotum of other calves in a group. It is stimulated by the intake of milk and linked to an unsatisfied motivation to suck (de Passillé, 2001), insufficient oral stimulation (Vaughan et al., 2012) or hunger (Herskin et al., 2010). Cows and calves also have a better chance to self-regulate the frequency and timing of suckling bouts which are reported to vary between 4 and 9 depending on calf age (Fröberg and Lidfors, 2009; Jensen, 2011) and is similar to that of cattle kept under semi-natural conditions (Reinhardt and Reinhardt, 1981).

Due to the calves' high milk intake and therefore loss of saleable milk for the farmer, separation is done prematurely, for instance at 8–12 weeks, which is long before natural weaning takes place, i.e., 8–12 months of age (Reinhardt and Reinhardt, 1981). One main disadvantage of the free contact system is the frequent, high pitched vocalizations by cows and calves which occur during the first days after separation and indicate severe distress (Johnsen et al., 2015c). Many farmers find this distressing, too. Following early weaning, calves often perform abnormal oral behaviours, partly because they are hungry (Jung and Lidfors, 2001). Suckling calves usually have low intakes of solid feed before weaning (Roth et al., 2009; Fröberg et al., 2011). The sudden shift of reliance on milk to solid feed results in a period of low weight gains post-weaning accompanied by behavioural signs of stress (Fröberg and Lidfors, 2009; Johnsen et al., 2015c). These findings clearly indicate that ways to increase solid feed intake of nursed calves pre-weaning as well as the development of weaning management systems that mitigate the growth check following weaning are needed before the free contact system can be recommended.

2.2. Restricted suckling contact

Restricted suckling systems imply that the calf is allowed to suckle its own dam during 1–2 short periods daily, often around milking hours. Cow and calf may for instance stay together for 2×15 min (de Passillé et al., 2008; Roth et al., 2009), or 2×30 min (Fröberg et al., 2007). For the rest of the day cow and calf are separated. Restricted suckling systems are commonly practiced in milk producing herds in tropical areas (Das et al., 2001; Fröberg et al., 2008). Restricted suckling contact occurs in tie stall systems in Norway, Sweden (Johnsen, personal communication) and

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