

# THE EFFECTS OF EARLY SEPARATION ON THE DAIRY COW AND CALF

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## Abstract

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*Most dairy producers believe that early separation of the cow and calf is necessary for reproductive efficiency, to minimise health problems and to improve the ease of milking. In addition, many consider that it is less distressing for both animals if separation occurs earlier rather than later. In this paper we review the welfare and production effects of early separation on the cow and calf. Research has shown that the cow's immediate behavioural response to separation from the calf increases with increased contact with the calf, but other work has shown that cow health and productivity are positively affected by the presence of the calf. Calf response to separation also increases when the calf spends more time with the cow, but there are long-term benefits of prolonged contact in terms of sociality, fearfulness and future maternal behaviour. Health, weight gain and future productivity are also improved when the calf is allowed to spend more time with the cow.*

**Keywords:** *animal welfare, behaviour, calf, dairy cow, separation*

## Introduction

Under natural conditions, cattle (*Bos taurus*) 'hide' their young away from the herd, returning at infrequent intervals during the day to suckle (Houpt & Wolski 1982; Phillips 1993). At about two weeks of age, calves are left in 'crèches' or groups during the day (Kilgour & Dalton 1984; Vitale *et al* 1986; Murphey *et al* 2000), forming social relationships with their peers. Cow and calf remain together until weaning at 6–8 months, whereupon bulls leave the herd forming bachelor groups while heifers remain, maintaining matriarchal bonds (Kilgour & Dalton 1984).

In contrast, on many commercial dairy farms, calves are abruptly separated from cows within a few hours of birth (Le Neindre & Sourd 1984; Margerison *et al* 1999). Dams return to the milking herd while calves are artificially reared in isolation or in groups. Calves are fed rationed quantities of milk or milk replacer by bucket or bottle, until weaning from milk to solid food at approximately 4–12 weeks old (Broom & Leaver 1978; Webster 1994). At weaning, calves are typically introduced into a group of animals of a similar age and weight (Le Neindre & Sourd 1984). Thus, unlike most livestock rearing practices in which separation from the dam and termination of milk-feeding occur simultaneously, these procedures are distinct for the dairy calf.

Producers suggest a number of reasons for separating calves early:

1) On economic grounds, preventing the calf from suckling may result in more milk for the producer. Calves must still be fed milk; however, many farms feed 'waste' milk (that which cannot be sold) or feed milk replacers that may be less costly than fresh milk.

2) Artificial rearing of calves allows for close monitoring of their food intake. Some producers believe that calves left with modern, high-producing cows may suckle too much milk, leading to diarrhoea and even death (Hammell *et al* 1988; Webster 1994). Monitoring individual food intake allows producers to check for signs of health problems (Thickett *et al* 1988). In addition, artificial rearing when combined with feeding pasteurised milk or milk replacers may minimise the spread of diseases such as Johne's disease (Roy 1990).

3) Suckling is thought to inhibit a cow's return to oestrus or sexual receptivity (Laster *et al* 1973). Oestrus is usually observed six months after birth in cows suckling calves, whereas cows without calves tend to ovulate 3–4 weeks after birth (Phillips 1993). Therefore, prevention of suckling by removal of newborn calves may allow the cow to enter oestrus more rapidly.

4) An important requirement for milking parlour efficiency is that cows have a quick 'milk let-down' reflex with minimal teat stimulation by the stockperson (Kilgour & Dalton 1984). Under conventional farm practice, cow milk let-down is rapid, but when cows are kept with calves the time to let-down may increase, extending milking time.

5) Finally, producers argue on compassionate grounds that early calf removal minimises the stress of separation for both the cow and calf (Phillips 1993). After parturition there appears to be a critical period for establishing the mother–infant bond (Edwards & Broom 1982). Some producers claim that if prolonged contact is allowed between dam and calf, a stronger bond is established, making separation more distressing for both animals (Stansfield 1991).

Given the benefits of early separation, why should there be concern over this practice? The Farm Animal Welfare Council (FAWC) and several other welfare organisations argue that early separation may not be in the best interests of the cow or calf for two reasons: first, it prevents the expression of normal behaviour (in this case maternal and suckling behaviour); and second, it is a cause of distress for both animals (Webster *et al* 1985; D'Silva 1993; Webster 1994; FAWC 1997).

In addition to the immediate effects of early separation, there may be consequences for the calf both during the days following separation and later in life once that animal has entered the milking herd. Early maternal and social deprivation can affect calf health and welfare as well as social status and milk production of cattle once they mature (Warnick *et al* 1977; Le Neindre & Sourd 1984; Arave *et al* 1992; Krohn *et al* 1999).

In this paper, we review the literature on the effects of separation on dairy cows and calves. Specifically, we examine the effects of separation at different ages on behavioural responses, health and production.

## **Effects of separation on the cow**

### ***Behavioural effects***

A number of studies have shown that increased periods of contact between cow and calf result in an increased behavioural response by the cow when separation eventually occurs. Indeed, one experiment (Hudson & Mullord 1977) showed that even 5 min of contact with the calf after birth results in behavioural distress of the cow upon separation, expressed by vocalisation and increased activity. Cows with no calf contact at all did not show these behaviours. Other studies have also reported that cows kept longer with their calves have stronger responses to separation. Lidfors (1996) investigated the behavioural effects of separating a dairy calf from its mother immediately and 4 days after birth. She concluded that

later separation leads to an increase in cow activity and vocalisation and a decrease in rumination. Weary and Chua (2000) evaluated the behavioural effects of separation, in this case at 6 h, 1 day and 4 days after birth, and found higher call rates when calves were removed after 4 days. Flower and Weary (2001) reported that cows separated from their calves at two weeks of age also showed stronger vocal and behavioural responses than those separated after just 1 day.

Two studies reported little effect of separation on the cow. Hopster *et al* (1995) examined the behavioural responses of cows, but only during the first 5 min after separation. More detailed work has now shown that the behavioural response actually peaks many hours after separation (Weary & Chua 2000; Flower & Weary 2001). Margerison *et al* (1999) examined the effect of abrupt separation at 4 days after birth versus continuous limited contact with a calf, but only made their comparisons 30, 60 and 90 days after separation.

Cow response to separation may also depend on previous maternal experience (a result of both the number of calves a cow has produced in her lifetime and the length of time spent with each). For example, Edwards and Broom (1982) observed the behaviour of 82 cow–calf pairs, up to 6 h after birth, and reported considerable behavioural differences in maternal responsiveness according to parity. Older cows were less likely to act aggressively toward their calves, and spent more time lying down after calving. Price *et al* (1986) reported a stronger behavioural response to temporary calf separation in multiparous versus primiparous beef cows. Flower and Weary (2001) found no effect of parity on cow behaviour after separation, but in this study even older cows had limited maternal experience as the standard practice in the study herd was to remove the calf within the first few hours of birth.

### **Health**

The cow is subject to a number of physiological changes associated with calving and the onset of lactation, and diseases such as ketosis and milk fever are common following birth (Sainsbury 1983). Interestingly, several days of suckling by calves has positive health benefits for the cow. First, suckling is known to accelerate the involution of the uterus following calving (Hafez 1980; Hunter 1980). Second, suckling has been shown in some work to reduce the risk of retained foetal membranes (Krohn *et al* 1990). This may help to explain why the incidence of retained foetal membranes is lower in beef cows (1%) than in dairy cows (8%; Noakes 1997). Third, suckling can reduce the amount of residual milk left in the udder and thus reduce the incidence and duration of mastitis in dairy cows (Payne 1990; Krohn *et al* 1999). For example, Krohn *et al* (1990) reported that the incidence of clinical mastitis was reduced by a factor of 2.5 when calves were kept with their mothers for 5 days compared with those separated immediately.

### **Production**

Metz (1987) compared the milk production of dairy cows kept with their calves for a short period (10 days) versus cows separated from calves immediately after birth, and estimated that nursing cows produced at least the same amount of milk as those that had been separated. Estimates were based on growth rates of calves and the milk output recorded in the parlour. After separation, milk yields rebounded to the same level as in the early-separation group. Similarly, Flower and Weary (2001) kept cows and calves together for two weeks and found that milk yields in the parlour were lower when calves were able to suckle. After separation, however, milk yields recovered to the extent that total yield over the lactation did not differ between the groups.

Separation practices may also affect the return to oestrus. Dairy cows are polyoestrous, with cycles recurring on average every 21 days. It is generally believed that the earlier cows resume cycling after calving, the greater the chance of a short calving–conception interval (Noakes 1997). Return to normal cyclical ovarian activity is influenced by a number of factors but suckling can inhibit return to oestrus by depressing luteinising hormone levels (the prerequisite for restarting ovulation) (Laster *et al* 1973; Carruthers & Hafs 1980). Inhibition is greater in cows kept with calves continuously than in cows suckled twice daily with limited contact (Terqui *et al* 1982). In developing countries, where calves continue to suckle until weaning, 177–206 day calving–conception periods are reported (Clemence & Ahmed 1993; Phipps *et al* 1993). However, a short continuous nursing period of 10 days after birth causes no delay (Metz 1987). In fact, Metz (1987) found that cows suckling calves for 10 days had a mean calving–conception interval of 66 days compared to 97 days for cows separated from calves immediately. Thus, separation within the first few weeks after birth appears to have little negative effect on the calving–conception interval.

## Effects of separation on the calf

### *Behavioural effects*

Under natural conditions, the dam is the calf's first social partner and calves gradually spend more time associating in peer groups as they age (Edwards & Broom 1982; Fraser & Broom 1997). Recent studies have found immediate effects of separation on calf behaviour and effects on social, maternal and coping behaviour later in life.

Lidfors (1996) found no difference in calf response between those separated at 4 days after birth and those separated after just a few hours with the cow. However, calf response to separation was measured only during the first 2 h after separation for those removed from dams at 4 days. Weary and Chua (2000) and Flower and Weary (2001) found that calves remain relatively quiet during the first few hours following separation, but those separated at older ages become more active and vocal 12–24 h later. Flower and Weary (2001) suggested that this delayed response to separation might be expected in 'hider' species, calves being adapted to periods of separation from the dam.

Studies on the effects of early rearing experience suggest that calf-rearing conditions in the first few months of life may influence subsequent social status in adulthood (Warnick *et al* 1977; Le Neindre & Sourd 1984; Arave *et al* 1985). Le Neindre and Sourd (1984) found that cow-reared calves (kept with a foster cow for up to 10 days and then allowed to suckle twice daily for two months) had higher social activity levels than calves that were artificially reared (removed from their mothers at birth). This difference was also reported by Krohn *et al* (1999) who suggested that maternal presence is important for learning social behaviour. The latter study conducted a social test, placing calves into an arena with an unfamiliar heifer. The authors found that calves which were allowed to stay with and suckle the cow during the first 4 days after birth were subsequently less fearful of other animals. Flower and Weary (2001) recorded the behavioural response of calves when they were first allowed to interact with another calf. Calves kept with dams for two weeks were scored as being more interactive during the test than those separated 24 h after birth and reared in isolation, suggesting that delayed separation allows the development of a more comprehensive social repertoire.

Under natural conditions, calves form relationships with their mothers and their peers. Therefore, it is not just a lack of contact with the mother but also a lack of contact with conspecifics that affects subsequent social behaviour. Isolation from conspecifics may lead to

abnormal behaviours, including stereotypies, and provides no opportunity to practice social skills or social learning (Broom & Leaver 1978; Jensen *et al* 1998). Thus the effects of early separation from the dam might be mitigated if calves were group-housed after separation (Donaldson *et al* 1972). Several studies have demonstrated that group rearing can affect subsequent social behaviour (eg Broom and Leaver 1978; Veissier *et al* 1994).

Non-nutritive sucking is common in young that are reared apart from their mothers (Wiepkema 1985; Rushen & De Passillé 1995). Calves separated at an early age are known to retain a high motivation to suckle and are often observed redirecting this behaviour towards their pen and pen-mates, especially after feeding (Margerison *et al* 1999). Redirected sucking on pen mates can cause injuries to the recipient and can lead to transfer of disease (Phillips 1993; Fraser & Broom 1997). Day and Webster (1999) suggest that this behaviour is displayed as a result of the sudden absence of the mother's udder. The use of artificial nipples for each calf and provision of *ad libitum* milk may alleviate this problem.

Le Neindre (1989) studied the effect of rearing experience on subsequent maternal behaviour by comparing cows that had been reared with foster cows for three months with cows reared artificially in isolation. The study demonstrated that mothered cows were more 'maternal' than non-mothered cows. In this case, maternal behaviour was assessed by the number and duration of suckling bouts, the number of attempts before successful suckling and total licking time.

Krohn *et al* (1999) used a human approach test to determine fearfulness of heifers aged 15–18 months old, and reported increased fearfulness of humans in heifers that had been kept together with their mothers for 4 days compared to those reared in isolation. However, calves separated later had also experienced less human contact than artificially reared calves, and handling is known to lower calf fear responses to humans (Boissy & Bouissou 1988; De Passillé *et al* 1996).

### **Health, nutrition and weight gain**

Newborn calves have no antibodies against neonatal infections and are entirely dependent on their mother's colostrum for immunological protection (Petrie 1984; Legatte 1996). Within the first 24 h after birth, a large transfer of immunoglobulins (Ig) from cow to calf takes place via colostrum (Stott *et al* 1979). The ability to absorb Ig decreases gradually with time after birth (Kruse 1970). Calves with low concentrations of absorbed Ig are more susceptible to diarrhoea (Petrie 1984). Several factors influence the absorption of Ig, the most important being calf age and the quantity of colostrum ingested. Selman *et al* (1970) discovered that the presence of the dam during the Ig absorptive period has a positive effect on absorption efficiency, perhaps because the cow stimulates the calf to stand and suckle earlier, as reported by others (Petrie 1984; Le Neindre 1989; Krohn *et al* 1999).

Some calves, however, may not suckle colostrum within the critical period of 24 h after birth. Wesselink *et al* (1999) examined colostrum intake of dairy calves and found that 33% of calves had not suckled within 24 h of birth. Both Edwards (1982) and Lidfors (1996) found that 32% of calves failed to suckle within 4 h and 6 h after birth, respectively. Edwards (1982) concluded that udder conformation of the cow affected the time to first suckling. Thus producers need to ensure that all calves receive colostrum soon after birth either by guiding the calf to the teats or by bottle-feeding.

There may be positive effects associated with continued colostrum intake in the days after birth. For example, Weary and Chua (2000) found that calves kept with cows for 4 days had fewer bouts of diarrhoea during the first three weeks of life than calves separated at 6 h or

1 day despite the fact that all calves were bottle-fed colostrum within 24 h of birth. These authors attributed the difference to local effects of colostrum in the gut wall after absorption of Ig had ceased (following Leece 1975).

Other positive health effects have been associated with maternal contact. For example, Metz and Metz (1986) showed that mother-reared calves defecate and urinate earlier after birth, as a result of frequent licking bouts. This study concluded that early removal of the meconium (first excretion) by dams promotes colostrum intake and digestive functions of the calf, important for health and survival. The expulsion of meconium may also be related to the quantity and composition of the milk ingested (Roy 1990).

Calves allowed to suckle dams for several weeks after birth also achieve greater daily weight gains (Metz 1987; Jonassen & Krohn 1991; Flower & Weary 2001) (Table 1), probably because they suckle more frequently and drink more milk. For example, Flower and Weary (2001) found that calves allowed to suckle freely on the cow for two weeks after birth gained weight at over three times the rate of calves separated early and fed a restricted quantity of milk (5% of the calf's body weight) twice daily. Metz (1987) also found much higher gains for calves kept with cows for 10 days after birth, and reported that these weight differences persisted for more than two months in some instances. Results of other studies suggest that early weight differences are maintained for up to 16 months (Smith *et al* 1973).

**Table 1** Average daily gain (ADG) of cow-reared and artificially reared calves.

	Age (days)	ADG cow-reared calves*		ADG artificially reared calves	
		<i>n</i>	(kg/day)	<i>n</i>	(kg/day)
<i>Flower &amp; Weary 2001</i>	0–14	12	1.17	12	0.32
	14–28		0.62		0.57
	0–28		0.90		0.45
<i>Lidfors 2000</i>	0–70	5	0.95	9	0.87
<i>Metz 1987</i>	0–10	50	1.09	28	0.53
	10–20		–0.05		0.08
	0–60		0.52		0.46

\* Calves separated from cows at day 14 (Flower & Weary 2001), day 70 (Lidfors 2000) and day 10 (Metz 1987)

### **Future productivity**

Early separation from the dam may affect future productivity. Following separation, calves are reared either individually in isolation or in groups of similar age and weight (Le Neindre & Sourd 1984). Creel and Albright (1988) hypothesised that stress resulting from neonatal isolation results in greater tolerance to stressors encountered as an adult and may actually enhance productivity. Early studies reported somewhat higher yields for heifers reared in social isolation than for heifers raised in groups (Warnick *et al* 1977; Arave *et al* 1985; Creel & Albright 1988), but a better controlled study (Arave *et al* 1992) failed to detect significant differences.

### **Animal welfare implications**

Separation is likely to have some welfare effect regardless of when it occurs, but the studies we have reviewed here show that the effects of imposed separation do vary with calf age. Allowing calves even a short period of contact with the cow increases behavioural response to separation, and this response increases with time that cow and calf spend together. Thus very early separation of cow and calf would appear to have some merits. However, other research

we have reviewed shows that early separation can cause problems with subsequent social behaviour, maternal behaviour and productivity. In evaluating the advantages and disadvantages of delaying separation (Table 2), we believe that the long-term benefits of late separation normally outweigh the relatively short-term distress associated with separation, even at later ages.

**Table 2** Advantages and disadvantages associated with delayed separation of cows and calves.

		Advantages	Disadvantages
<i>Cow</i>	<i>Behaviour</i>	Ability to express maternal behaviour	Increase in activity at time of separation Increase in vocalisations at time of separation Decrease in rumination at separation
	<i>Health</i>	Lower incidence of retained foetal membranes Lower incidence of mastitis	
	<i>Production</i>	Overall milk yield not affected by presence of calf Shorter calving–conception interval	
<i>Calf</i>	<i>Behaviour</i>	Lower incidence of redirected suckling Less fearful of conspecifics Higher social activity levels More maternal at calving	Increase in vocalisations after separation More fearful of handlers
	<i>Health</i>	Lower incidence of diarrhoea Defecate and urinate earlier after birth More efficient absorption of colostrum	
	<i>Production</i>	Greater average daily weight gain	

### Future challenges

A number of important challenges remain to be addressed. One problem associated with delayed separation is that it becomes increasingly difficult to establish calves on a new milk feeding system (buckets or teat) as they age. Thus there may be advantages to keeping calves with cows until they can be weaned onto solid food. Alternatively, several calves can be left with nurse cows for longer periods (eg Lidfors 2000). In either case, delayed separation is likely to lead to increased behavioural responses when separation does occur, so management practices that can reduce this response will need to be developed.

Another promising approach is to separate calves soon after birth, but develop improved rearing systems for the calves. Examples include *ad libitum* nipple feeding that allows for more natural feeding behaviour and improved weight gains (Appleby *et al* 2001; Jasper & Weary 2002), and rearing calves in small groups (Chua *et al* 2002). Recent experimental evidence also indicates that the calf's response to early separation is in large part due to much less frequent feeding (normally twice a day) compared to when kept with the cow (suckling on average about six times a day) (Thomas *et al* 2001). Thus the behavioural response to early separation can be much reduced by simply feeding calves more often after separation. In any case, much work will be required to determine appropriate management conditions for these alternatives that are both practical for dairy producers and work well for the cow and calf.

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