Group Housing and Milk Feeding of Dairy Calves

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Take Home Message

- Social contact improves social skills and stimulates solid feed intake
- Keeping calves in small and stable groups reduces competition for milk and reduces risk of disease
- Use of a teat for milk feeding reduces cross sucking and allows calves to express their natural suckling behaviour
- Computer-controlled milk feeding functions best when feeding a high milk allowance and few restrictions are placed on when and how much calves can drink
- Enhanced milk feeding improves growth and calf welfare

Introduction

The dairy calf is typically individually housed from birth to protect it from pathogens and to make it easier to monitor milk intake and health, but this deprives the calf of opportunities for social interaction with other calves. Calves are traditionally fed a limited amount of milk to stimulate concentrate intake and to facilitate early weaning off milk, but this practice is associated with poor growth and chronic hunger in calves. Here we review recent research that is showing advantages of grouping and milk rations for the welfare and performance of the pre-weaned dairy calf.

Group Housing Improves Development of Social Skills

When housed in groups, calves have opportunity to interact socially and to develop social skills likely to be helpful later in life. A number of recent studies have shown that socially housed calves (kept in pairs or small groups) are

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less fearful of unfamiliar calves; for example, they are more willing to approach an unfamiliar calf (De Paula Vieira et al., 2012) and have a lower heart rate during the confrontation (Jensen et al., 1997). In contrast, individually reared calves are less able to regulate social interactions (De Paula Vieira et al., 2012), for example, showing more social pushing and mounting (Duve and Jensen, 2011) than pair-housed calves.

Some types of individual pens allow tactile contact between calves housed in neighbouring pens. Calves housed in this way do interact with calves in neighbouring pens starting at about 12 days of age, but the level of social behaviour is lower than that between pair-housed calves (Duve and Jensen, 2012). Moreover, these calves show deficits in social behaviour similar to calves housed in individual pens (Jensen et al., 1999), indicating that limited social interaction among calves in adjacent pens has little effect of the development of social skills.

■ Social Contact Provides Social Support

Social support is defined as the enhanced ability to cope with challenges when with a social partner (Rault, 2012). For example, when left alone calves vocalize if separated from a group mate, but remain silent if kept with at least one known peer (Færevik et al., 2006). Socially housed calves struggle less than individually housed calves when restrained for blood sampling (Duve et al., 2012). Calves typically vocalize when weaned from milk, but socially housed calves vocalize much less than individually housed calves (De Paula Vieira et al., 2010).

■ Calves Prefer Familiar Companions

Pre-weaned dairy calves housed in groups prefer a peer to an unfamiliar calf in a choice test (Færevik et al., 2006; Duve and Jensen, 2011), and it appears that social relationships formed early in life are long lasting (Raussi et al., 2010). Calves kept in their original and stable group engage in fewer aggressive interactions and are more tolerant towards each other during feeding than regrouped animals (Mounier et al., 2006). If calves are regrouped, it may be beneficial to maintain the original group within a larger group. Færevik et al. (2007) found less aggression and more positive social interactions among newly weaned dairy calves that were regrouped by mixing two original groups than among calves where the original groups were sub-divided.

■ Social contact improves production

Social facilitation can encourage intake of solid feed and improve weight gains. Several studies now have shown higher intakes of solid feed in group-

housed calves, including calves on a low milk allowance that were group housed at one week (Babu et al., 2004; Phillips, 2004; Hepola et al., 2006) or four weeks of age (Tapki, 2007), as well as in *ad libitum* fed calves (De Paula Vieira et al., 2010). Early solid intakes, combined with the reduced distress response described above, are likely responsible for the better performance of socially housed dairy calves during the weaning period (Chua et al., 2002). Indeed, De Paula Vieira et al. (2010) found that pair-housed calves resumed concentrate feeding more rapidly and consumed more concentrate after weaning than did calves that had previously been housed individually.

■ Social Contact May Also Improve Cognitive Performance

Higher concentrate intake post-weaning also may be due to better learning abilities. Socially housed calves appear to be able to learn how to use new automated feeding equipment (De Paula Vieira et al., 2010), perhaps because they are generally better able to learn or perhaps specifically better able to learn from pen mates. Duve et al. (2012) found that following grouping at 8 weeks previously pair-housed calves more quickly accessed concentrates and spent more time eating concentrates than previously individually housed calves when space at the feed manger was limited.

■ Social Factors Affecting Health

Conventional wisdom would suggest that individual housing is superior when it comes to calf health, and some research supports this idea. For example, one study found higher mortality for calves housed in groups before the age of 1 month compared to individually housed calves (Gulliksen et al., 2009), and a second study found that group-housed calves had a higher risk of respiratory disease (Svensson et al., 2006). However, in the latter study, the risk of respiratory disease after weaning was highest among calves housed in large groups; calves in small groups (<8 calves) had the best health outcomes.

Other studies have shown that group size is important for calf health. Lundborg et al. (2003) found a lower daily gain among calves in large versus smaller groups (<8 calves). Svensson et al. (2003) found more severe cases of diarrhea among calves in large groups. Losinger and Heinrichs (1997) found that a group size of more than 7 animals was associated with a higher mortality among heifer calves. Svensson and Liberg (2006) found that calves in groups of 8 had a 40% lower risk of respiratory disease and a 40 g higher daily gain than calves in groups of 16. Together these results suggest that the health risk of group housing is related to group size.

Pig producers have known for years the value of all-in-all-out management for managing disease, but many dairies continue to use dynamic grouping. Little research has examined the effects of group dynamics on the health of dairy calves, but in one study (Pedersen et al., 2009) calves kept in stable groups (all-in-all-out) had higher daily gains and a lower incidence of disease than did calves housed in dynamic groups in which new animals were continuously introduced.

■ Cross Sucking

One problem associated with group housing is cross sucking; a redirection of the natural sucking behaviour towards peers. Offering calves the opportunity to use their natural sucking behaviour to ingest milk greatly reduces the risk that calves will begin to suck one another (De Passillé, 2001). Outlets for natural sucking behaviour include teat-buckets, simple teat-feeders, and computer-controlled milk-feeders.

When the milk is offered in teat-buckets, the calves spend more time ingesting the milk (Appleby et al., 2001), and perform less cross-sucking after the ingestion of milk (Jensen and Budde, 2006).

■ Competition for Milk

Another issue associated with group housing is competition for milk. Ideally each calf should have access to its own milk teat; reducing the ratio of teats to calves increases competition, reduces feeding time, and reduces milk intake (von Keyserlingk et al., 2004). But even when each calf has a teat, competition can occur, in part because of the natural teat switching behaviour of dairy calves that increases when milk flow begins to decline (Haley et al., 1998). Calves switch teats more when each teat is connected to a separate bucket than when all teats are connected to one large shared container, and providing the milk in separate buckets does reduce competition (Nielsen et al., 2008a). One way of reducing competition for milk is to place barriers between the teats. Jensen et al. (2008) found that long barriers separating calves' heads and shoulders reduced displacements and prevented milk stealing, but barriers that only separated the calves' heads had little effect.

■ Computer-Controlled Milk Feeding

Computer-controlled milk feeders allow producers to program when and how much milk each calf in a group is able to drink. Unfortunately some competition is inherent with these feeders with sometimes 20 or more calves sharing a single feeding station. These feeders normally use a raceway to access the teat that limits the ability of one calf to displace another from the teat, but these displacements still occur. For example, Jensen (2004) found

that calves housed in groups of 12 (with a single feeder) were disturbed by other calves during 10% of their feeding time, but calves in groups of 24 to a feeder were disturbed 50% of the time. This competition increases the risk of cross sucking, as motivation to suck is closely associated with motivation to drink milk (de Passillé, 2001).

A mechanical method of reducing the competition and cross sucking is to install a gate at the entrance to the race that allows the calf to stay in the feeder undisturbed (Weber and Wechsler, 2001), but competition and cross sucking can also be reduced by improving the way these feeders are managed.

Milk feeders are typically programmed to provide restricted amounts of milk allocated in several daily milk portions of a restricted size. These restrictions affect the calves' use of the feeder. Calves offered their daily allowance of 6.4 L in 4 portions rather than 8 portions occupied the feeder less time per day (Jensen, 2004). Irrespective of how much milk the calf is offered, the motivation to suck is stimulated at every milk feeding (Rushen and de Passillé, 1995). Therefore, calves will occupy the feeder for longer when they receive the same allowance allocated to more portions.

When calves suckle the dam the meal size increases and the meal frequency declines during the first month of life from 8-12 to 3-4 meals per day (Jensen, 2003), but calves are able to adjust to twice daily feeding with no decline in intake or evidence of other harm (von Keyserlingk et al., 2006). Indeed, forcing the calves to drink smaller portions than they prefer, and drink these in several meals, can have negative effects. When Jensen (2009) offered calves a high milk allowance, with little restriction on the number of milk portions or maximum portion size, calves had fewer milk meals as they aged mimicking the development from small and frequent milk meals to fewer and larger meals reported on studies of natural suckling. In contrast, calves provided a low milk allowance continued to have a high number of milk meals throughout the milk-feeding period because they consistently ingested milk as soon as it became available to them, likely associated with chronic hunger in these underfed animals.

■ Benefits of Feeding More Milk

Holstein calves readily ingest 10 or more L of whole milk daily (Jasper and Weary, 2002; von Keyserlingk et al., 2004; Sweeney at al., 2010), about twice the ration traditionally offered. Calves offered approximately 5 L/d of replacer (Jensen and Holm, 2003; Jensen, 2004; Nielsen et al., 2008b) or whole milk (De Paula Vieira et al., 2008) via computer-controlled milk feeders visit the feeder much more often than do calves fed more milk; many of these visits are unrewarded meaning that the calf enters the feeder but is allocated no milk. The high frequency of unrewarded visits suggests that these calves are

highly motivated to drink more milk. Calves fed just 5 L/d also vocalize more often and more loudly than calves fed 8 L/d (Thomas et al., 2001), again indicating that these limit-fed calves are hungry. Limit feeding also reduces play behaviour (Krachun et al., 2010), suggesting that the chronic hunger reduces mood and opportunities for positive effect in these calves.

The rationale behind these limited milk rations is stimulating concentrate intake. However, calves consume almost no concentrate before two weeks of age and are not able to compensate for low milk by increased concentrate intake early in life (for review see Khan et al., 2011). As a consequence, limit-fed calves have markedly lower nutrient intakes and daily gains compared to calves offered high milk allowances. For example, much lower daily gains were found in calves fed 5 L/d versus 8 L/d (Jensen, 2006), calves fed 10% of BW versus *ad libitum* (Jasper and Weary, 2002), and calves fed 20% of BW versus 10% of BW (Khan et al. 2007).

The effects of low milk rations may be especially problematic during periods of cold weather. The nutrient demands of calves for maintenance increase with low temperatures (Drackley, 2008), and increased mortalities are associated with lower energy supply in winter (Godden et al., 2005).

Finally, higher growth rates early in life (associated with higher milk intake) have been linked to reduced breeding age (Raeth-Knight et al., 2009) and higher milk yields (Moallem et al., 2010). One recent study (Soberon et al., 2012) found that about 25% of the variation in milk production over the first lactation was associated with weight gains before weaning. Together these results indicate that increased milk rations have important benefits.

■ Weaning Calves Fed Higher Rations of Milk

Providing calves more milk does reduce intake of concentrates, making weaning more difficult. Weaning from milk can result in a period of undernourishment when calves no longer have access to milk but are unable to consume and digest sufficient quantities of solid food. The lag in nutrient intake and associated growth check are likely to be more severe if calves are weaned abruptly (Weary et al., 2008).

Fortunately, research has illustrated several methods of stimulating the intake of solid food pre-weaning and reducing growth check in the post-weaning period (Khan et al., 2011). For instance, a feeding program where calves are initially offered high milk (20% BW) during the first weeks of life, followed by lower amounts (10% BW) in the weeks before weaning, results in increased intakes of concentrates and allows calves to be weaned with little or no growth check (Khan et al., 2007; Sweeney et al., 2010). Other approaches to increasing intakes of solids before weaning include weaning at later ages (De

Passillé and Rushen, 2012), and group housing (De Paula Vieira, 2010) perhaps especially with older animals (De Paula Vieira et al., 2012).

■ Conclusion

When calves are group housed they learn normal social skills and form social relations. Social contact stimulates early intake of solid feed and group-housed calves cope better with challenges such as weaning and regrouping. This may be especially true if the original groups are maintained.

Milk feeding management of group-housed calves is a challenge. Teat-based systems reduce problems of cross sucking. Providing multiple teats reduces competition for milk, especially if these are physically separated. Computer-controlled milk feeders function best if milk allowance is high, if minimal restriction is placed on the milk meal patterning, and if group size is small.

Health problems related to group housing are to a large extent due to large group sizes and dynamic group structures, while the benefits of social contact are achieved by housing calves in pairs or small groups. Concern for natural behaviour versus health has often been viewed as a dilemma when discussing group housing, but keeping groups small and stable takes both concerns into account.

Limited fed calves are hungry. Early in life, limited fed calves cannot ingest sufficient amounts of concentrate to meet their nutrient demands. Increasing the milk allowance results in improved performance and the transition to solid feed may be ensured by a gradual step down from high milk rations to lower milk rations in the weeks before weaning.

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