Group-housed feeding systems for dairy calves

Mark J. Thomas,[1] *DVM, DABVP-Dairy;* **Michael Capel,**[2] *DVM*
[1]*Dairy Health & Management Services, LLC, Countryside Veterinary Clinic, LLP, Carthage, NY 13619*
[2]*Perry Veterinary Clinic, Geneseo, NY 14454*

Abstract

The practice of group, ad libitum feeding of pre-weaned calves has recently re-emerged in North America as an alternative to individual housing and management. The interest in these systems has largely been driven by the desire to optimize growth rates through the increased intake of milk or milk replacer, and to reduce labor and management requirements. The benefits of increased rates of gain in milk-fed calves have been well documented through a number of key research trials and meta-analyses. In addition to the apparent health benefits to the young calf, the long-term effect on future milk production has been recognized.

As calf feeding programs have evolved, there has often been the challenge of allowing the calf to consume sufficient milk to meet the needs of accelerated growth. Free access to milk or milk replacer has provided the opportunity to maximize intakes and capitalize on some of the potential benefits of early socialization in a group environment. Additionally, acidification of milk or milk replacer has been shown to have some direct benefits in reducing enteric diseases, and has made it easier to alter traditional management systems.

Some new challenges have also arisen with these feeding and management systems. The ability to provide sufficient ventilation, space, and bedding is a key aspect of minimizing the effect of disease in the group-housed environment. This paper reviews the practical application of group feeding of milk-fed calves, with emphasis on application of ad libitum, acidified milk or milk replacer feeding.

Key words: calves, dairy, feeding, milk replacer, management

Résumé

La pratique de l'alimentation à volonté en groupe pour nourrir les veaux présevrés est récemment réapparue en Amérique du Nord en tant qu'alternative à la régie basée sur la stabulation individuelle. L'intérêt dans ces pratiques est maintenu en partie par le désir d'optimiser le taux de croissance en augmentant l'apport de lait ou de lait de remplacement tout en réduisant la main d'œuvre et les besoins de régie. Les avantages d'une augmentation du taux de gain chez les veaux de lait ont été bien établis avec plusieurs essais cliniques et des méta-analyses. En plus des bénéfices au niveau de la santé chez le jeune veau, les effets à long-terme sur la production future de lait ont aussi été reconnus.

En développant ces programmes d'alimentation, on fait souvent face au défi de permettre au veau de consommer assez de lait pour répondre aux besoins reliés à la croissance accélérée. L'accès à volonté au lait ou au lait de remplacement donne la chance de maximiser la prise alimentaire et tire profit des bénéfices potentiels associés à la socialisation hâtive dans un environnement de groupe. De plus, l'acidification du lait ou du lait de remplacement permettrait d'avoir quelques bénéfices directs en réduisant les maladies entériques et faciliterait aussi les changements dans la régie traditionnelle.

De nouveaux défis sont aussi apparus avec ces nouveaux systèmes de régie et d'alimentation. La capacité de fournir une ventilation suffisante et d'avoir assez d'espace et de litière sont des éléments clés afin de minimiser les effets de la maladie lorsque les animaux sont logés ensemble. Cet article fait le survol de l'application pratique de l'alimentation en groupe des veaux de lait et met l'accent sur l'alimentation à volonté avec du lait acidifié ou du lait de remplacement.

Introduction

The benefits of increased rates of growth in pre-weaned, milk-fed calves have been documented through a number of well-designed research trials and meta-analyses. A review of the current literature showed that increasing the intake of milk pre-weaning resulted in 990 to 2860 lb (450 to 1300 kg) increased first-lactation milk yield, compared to conventionally fed calves.[3,6,11,14,18] Soberon recently completed an analysis of the impact of pre-weaning growth on milk production using the test-day model over multiple lactations.[15] Within 2 dairy herds, it was found that every additional 2.2 lb (1 kg) of pre-weaning ADG resulted in 2,138.5 lb (970 kg) more first-lactation milk yield.

The effect of the increased level of nutritional support on immune function and health is very evident from a practical aspect, but has also been well documented in a number of studies. Ballou demonstrated the enhanced immune responses of Holstein and Jersey calves during the pre-weaning and immediate post-weaned periods when fed milk replacer on an increased plane of nutrition.[2] A classic challenge model showed the beneficial effect of an increased nutritional plane on health and

performance in dairy calves after experimental infection with *Cryptosporidium parvum*.[12]

Given the knowledge of these benefits, along with a desire to improve labor efficiency, within the past 10 years the interest in ad libitum calf feeding and group housing has grown considerably in the northeast United States. As larger dairy operations have adopted these systems, there has been a considerable learning curve for the development of both physical facilities and feed delivery systems that can efficiently manage the modern dairy calf in these programs.

Delivery Systems

Feed delivery has evolved from the gang-type feeders common in New Zealand to both commercial automated systems and on-farm designed systems. As the desire to reduce labor and provide ad libitum feeding has developed, the practice of preserving of milk with organic acids has also evolved.[1] The use of formic acid as a milk preservative is most common, followed by the use of citric acid and proprietary organic acid blends. The optimal pH for effective preservation is within the range of 4.0 to 4.2. Acidification to levels below 4.0 often inhibits intake, and ineffective preservation and bacterial growth are common with a pH above 4.5.

The practical process of milk acidification is not without challenges. Acid will readily cause milk to coagulate and produce a product that will not flow through tubing and nipples. The 3 main areas where attention is critical are: 1) the rate at which the acid is added, 2) the temperature of the milk during acidification and 3) the effective agitation of the milk during the acidification process. To attain the proper pH without coagulation of milk, it is critical that the dilute acid be added to cool (<70°F; 21°C) milk at a slow rate with aggressive agitation during addition. Whole milk (both unpasteurized and pasteurized) and milk replacer are commonly acidified.

The acidification process has allowed for the development of a wide range of feeding systems that do not require a method to keep milk cold. The most sophisticated systems rely on an automated system to potentially mix (milk replacer), warm, deliver and monitor milk or milk replacer feeding to the calf. These systems can provide individual calf intake and growth data and allow for considerable customization of feeding programs at the individual calf level.

Other systems range from the most basic to very sophisticated and automated on-farm designs. The basis of all systems is a vessel to hold the milk at a feeding temperature of 90 to 100°F (31.9 to 37.7°C) and a series of milk lines and nipples to provide ad libitum availability of milk or milk replacer. Most on-farm designed systems have the availability to provide an unlimited number of nipples, potentially decreasing the competition for feeding locations.

The acidification process may also provide a direct benefit to enteric health, given few pathogenic enteric pathogens survive at a pH below 4.5.[19] The dramatic reduction in the incidence of diarrhea seen in these systems is likely due to the improved level of nutritional support combined with the reduction in pathogenic bacteria.

Although approved and widely used for the acidification of livestock water and swine and poultry feeds, it must be noted that formic acid is currently not approved or labeled for the acidification of milk in the US.

Weaning Strategies

There are many options to consider when designing a weaning strategy. Many of these options will be dictated by the facility and feed delivery system in place on the farm.

Transition to Solid Feed

Ensuring that calves are eating an appropriate amount of starter grain (2 lb per day; 0.91 kg) has been a common recommendation. This is relatively easy to achieve in conventional 2- or 3-times daily feeding systems because as calves grow, their energy and protein requirements increase over that delivered through milk intake. This provides an incentive for calves to make up the difference through starter grain intake. In ad libitum or high-volume liquid feed systems, calves can meet their needs through liquid feed alone. This leads to lower levels of starter intake pre-weaning, and potentially a more difficult transition during the weaning process.[13]

A more gradual weaning process over 7 to 10 days is generally recommended for calves reared with ad libitum feeding systems. A gradual decrease in the volume of milk offered over this period allows for an increase in solid feed intake, along with the maintenance of the required nutrients to support immune function and growth.[8]

Facilities

Facility design is integral to the health of calves. Major considerations for facility design include stocking density, ventilation, drainage, and labor efficiency (feed delivery, cleaning/bedding, calf handling). Calf pens should be designed to provide a minimum stocking density of 35 sq ft (3.3 sq m) per calf. This recommendation is very important, and is often overlooked as farms expand and facilities become overcrowded.

Group rearing may provide additional benefits in growth and development as compared to individually raised calves. Calves housed in groups have been shown to have decreased responses to restraint, increased play,

and competitive success for feeding opportunity.[5] They are also much less reactive to new experiences in their environment.[4] Rearing calves in smaller groups has shown to be advantageous to health and growth.[16] Additionally, maintaining an age range of 7 to 12 days has been recommended,[10] which may decrease competitive forces and improve intakes.

Ventilation

Naturally ventilated barns with curtain sidewalls and an open center ridge vent are a popular design for adult and heifer housing, and have been adapted for calf facilities. This type of design does not provide effective ventilation for pre-weaned calf housing, because these barns rely on the effect of thermal buoyancy. There is little heat generated by pre-weaned cattle; therefore, there is no updraft and movement of warm, moist air and gases to the ridge vent.

Positive pressure ventilation tubes have recently gained popularity, and are a superior system to provide the proper number of air exchanges and maximize ventilation during cold and mild environmental temperatures. These systems are not adequate for moving enough air for heat abatement, and supplemental systems may be needed to provide adequate cooling. Neutral pressure ventilation systems can also be designed to provide 100% mechanical ventilation during all seasons.

Another important focus is to minimize the amount of air contamination from mechanized bedding systems. Extremely dusty environments can have a negative impact on respiratory health.

Bedding and Floor Surface

Adequate amounts of clean, dry bedding are essential for calves. Sufficient bedding to allow for nesting has been shown to be one of the major factors in reducing the incidence of pneumonia in pre-weaned calves.[9] Calves fed a higher plane of nutrition consume more water and produce more urine than traditionally fed calves. This in turn creates a wetter environment requiring significantly more bedding and the need for improved drainage. Careful consideration should be given to the slope and drainage of the calf pens in order to minimize bedding costs and maximize calf health.

Conclusions

Group housing and ad libitum feeding of calves has become a successful alternative to traditional methods of calf rearing. The ability to preserve milk and/or use automatic feeders has allowed this process to evolve. There are many well documented advantages for the growth and health of calves provided augmented nutrition. As with all systems, challenges exist as the methods to house and feed calves in groups continues to evolve.

References

1. Anderson N. Mimicking nature's way for milk-fed dairy calves: Free-access feeding with acidified milk. Ontario Ministry of Agriculture Affairs, 2006. Available at: http://www.omafra.gov.on.ca/english/livestock/dairy/facts/mimick.htm. Accessed January 12, 2013.
2. Ballou MA. Immune responses of Holstein and Jersey calves during the preweaning and immediate postweaned periods when fed varying planes of milk replacer. *J Dairy Sci* 2012; 95:7319-7330.
3. Bar-Peled U, Robinzon B, Maltz E, Tagari H, Folman Y, Bruckental I, Voet H, Gacutua H, Lehrer AR. Increased weight gain and effects on production parameters of Holstein heifer calves that were allowed to suckle from birth to six weeks of age. *J Dairy Sci* 2010; 80:2523-2528.
4. De Paula Viera A, de Passille AM, Weary DM. Effects of the early social environment on behavior responses of dairy calves to novel events. *J Dairy Sci* 2012; 95:5149-5155.
5. Duve LR, Weary DM, Halekoh U, Jensen MB. The effects of social contact and milk allowance on responses to handling, play, and social behavior in young dairy calves. *J Dairy Sci* 2012; 95:6571-6581.
6. Foldager J, Krohn CC. Heifer calves reared on very high or normal levels of whole milk from birth to 6-8 weeks of age and their subsequent milk production. *Proceedings Soc Nutr Physiol* 1994; 3:301.
7. Jasper J, Weary DM. Effects of ad libitum milk intake on dairy calves. *J Dairy Sci* 2012; 85:3054-3058.
8. Khan MA, Lee HJ, Lee WS, Kim SB, Ki KS, Ha JK, Lee HG, Choi YJ. Pre- and postweaning performance of Holstein female calves fed milk through step-down and conventional methods. *J Dairy Sci* 2007; 90:876-885.
9. Lago A, McGuirk SM, Bennet TB, Cook NB, Nordlund KV. Calf respiratory disease and microenvironments in naturally ventilated calf barns in winter. *J Dairy Sci* 2006; 89:4014-4025.
10. Lorenz I, Early B, Gilmore J, Hogan I, Kennedy E, More SJ. Calf health from birth to weaning III. Housing and management of calf pneumonia. *Irish Vet J* 2011; 64:14.
11. Moallem U, Werner D, Lehrer H, Zachut M, Livshitz L, Yakoby S, Shamay A. Long-term effects of ad libitum whole milk prior to weaning and prepubertal protein supplementation on skeletal growth rate and first-lactation milk production. *J Dairy Sci* 2010; 93:2639-2650.
12. Olivett TL, Nydam DV, Linden TC, Bowman DD, VanAmburgh ME. Effect of nutritional plane on health and performance in dairy calves after experimental infection with Cyrptosporidium parvum. *J Am Vet Med Assoc* 2012; 241:1514-1520.
13. Passille AM, Borderas TF, Rushen J. Weaning age of calves fed a high milk allowance by automated feeders: Effects on feed, water, and energy intake, behavior signs of hunger, and weight gains. *J Dairy Sci* 2010; 94:1401-1408.
14. Shamay A, Werner D, Moallem U, Barash H, Bruckental I. Effect of nursing management and skeletal size at weaning on puberty, skeletal growth rate, and milk production during firstlactation of dairy heifers. *J Dairy Sci* 2005; 88:1460-1469.
15. Soberon F, Raffrenato E, Everett RW, Van Amburgh ME. Preweaning milk replacer intake and effects on long-term productivity of dairy calves. *J Dairy Sci* 2012; 95:783-793.
16. Svensson C, Liberg P. The effect of group size on health and growth of Swedish dairy calves housed in pens with automatic milk-feeders. *Prev Vet Med* 2006; 73:43-53.
17. Sweeney BC, Rushen J, Weary DM, de Passille AM. Duration of weaning, starter intake, and weight gain on dairy calves fed large amounts of milk. *J Dairy Sci* 2010; 93:148-152.
18. Terre M, Devant M, Bach A. Effect of level of milk replacer fed to Holstein calves on performance during the preweaning period and starter digestibility at weaning. *J Livestock Sci* 2007; 110:82-88.
19. Yanar M, Guler O, Bayram B, Metin J. Effects of feeding acidified milk replacer on the growth, health and behavioural characteristics of Holstein Friesan calves. *Turk J Vet Anim Sci* 2006; 30:235-241.
20. von Keyserlingk MAG, Wolf F, Hotzel M, Weary DM. Effects of continuous versus periodic milk availability on behavior and performance of daily calves. *J Dairy Sci* 2006; 89:2126-2131.