

Comparing group pens to individual pens for inside feeding of dairy calves—top 10 considerations

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Abstract

Feeding and housing calves in groups is becoming increasingly popular in North America. This has been driven by the desire for increased labor efficiency and improved quality of life for caregivers during inclement winter weather. Raising calves in this manner requires a high level of commitment and management. This review will discuss the top 10 factors important for veterinarians advising clients about adopting indoor, group feeding.

Key words: bovine, dairy, calves, housing

Résumé

Nourrir et loger les veaux dans des groupes est de plus en plus populaires en Amérique du Nord. Cela a été motivée par le désir d'accroître l'efficacité du travail et amélioration de la qualité de vie des aidants dans de mauvaises conditions météorologiques hivernales. Qui élève des veaux de cette manière requiert un niveau élevé d'engagement et de la gestion. Cette revue discute de la top 10 facteurs importants pour les vétérinaires à conseiller les clients au sujet de l'adoption d'intérieur, alimentation en groupe.

Introduction

Approximately 63% of commercial heifer raisers in the eastern portion of the US house pre-weaned calves indoors.²² Although individual, outdoor housing remains the gold standard for raising healthy calves, the desire for greater flexibility, efficiency, and quality of life for caregivers has driven the recent shift towards indoor, group housing and feeding.

Using automatic calf feeders (ACF) and indoor, group housing requires excellent animal husbandry and environmental management. Failure of passive transfer, poor ventilation, inconsistent nutrition, direct contact between calves, unsanitary environments, and stressful procedures contribute to poor growth and high rates of disease in these facilities. We must take into account several other factors that are unique to group feeding:

- Group size
- Age at introduction to the ACF
- Delivery of nutrition prior to introduction to the ACF
- Cleaning, calibration, and quality control of equipment

- Volume and nutritional density of feeding from the ACF
- Nutritional consistency prior to and while on the ACF
- Cross sucking
- Weaning strategy
- Screening for disease and growth
- Monitoring and oversight

Group Size

When using ACF, the size of the group is often dictated by the company selling or installing the equipment, with 25 to 30 calves/feeding station often recommended. Unfortunately, calves grow better and have lower risk for pneumonia when group size is less than 12 to 18 calves.²⁰ Reduced access to the nipple as a result of too many calves is also associated with a greater number of competitive interactions, decreased feeding time, and decreased milk intake.²⁴

Large groups inevitably have a wider age range between the oldest and the youngest calf, exposing the susceptible younger calves to a greater risk of disease. Although it is difficult to establish in smaller operations, 1 week is the ideal age range within a pen. Crowded and/or highly populous pens also impede our ability to detect sick calves. Continuous introduction of calves is a constant source of social stress and at least 1 study has shown that calves have higher growth rates when moved in socially stable groups.⁷ The ideal group size is most likely less than 10 animals.²⁰

Age at Introduction to the ACF

Young calves are less competitive and require more guidance to the feeder compared to calves that are older at introduction.¹¹ These calves also spend less time at the feeder during the 12 days after introduction and consume significantly less milk.¹¹ Early introductions will require once or twice daily assistance to the feeder. Clinical experience has shown poor performance in calves moved to the group within the first 2 days of life, particularly during cold weather. It is preferred to group calves after 10 to 14 days of age, once these animals are past their risk period for scours.

Delivery of Nutrition Prior to Introduction to the ACF

The method of feeding, volume, and nutritional density of the milk or milk replacer should be as consistent as

possible with the system used within the group. Calves will undergo some degree of stress when transitioning from 2 to 3 large meals per day to several small meals. Studies have shown that offering fewer, larger meals (4 meals/day vs 8 meals/day) reduces competition for the feeder and may be more beneficial in large, highly competitive groups.¹⁰

Cleaning Equipment

Whether using ACF, cleanliness is of utmost importance as multiple calves nursing on a single nipple enhances the buildup of pathogens. Producers have control over the brand and volume of cleaning agent, frequency of cleanings, hose type, frequency of hose replacement, and mixer and hose drainage. Cleaning can be manually or automatically initiated and involves a pre-clean rinse, wash cycle with detergent, and lastly a water rinse. Cleaning agents should function at 104 to 122°F (40 to 50°C) and may either be alkaline (to remove fat deposits) or acidic (to remove mineral deposits). Chlorine bleach may be used at slightly lower temperatures (75 to 100°F) (23.9 to 37.8°C) but should be mixed with other cleaning agents.⁶ Ideally, the whole circuit (feeding hoses included) is cleaned daily and the mixer and associated heat exchanger (HE) is cleaned twice/day. Increasing the frequency of mixer/HE cleanings keeps bacteria levels lower. In a recent Virginia Tech study⁶ only 40% of facilities were cleaning appropriately. Feeder hoses should be replaced every 1 to 2 weeks, whereas mixer hoses are replaced less often. Nipple ends will deteriorate more quickly, increasing the risk for aspiration pneumonia secondary to flooding of the pharynx by excessive milk. Samples taken directly from the nipple, mixer, and hoses can be checked for excessive bacterial counts. Total bacterial counts < 10,000 cfu/mL and 0 cfu/mL fecal coliforms are recommended and achievable.^{6,14}

Volume and Nutritional Density of Milk from the Automatic Calf Feeder

Automated feeding systems have an advantage over many hand-feeding systems in being able to customize feeding strategies to efficiently deliver more milk or milk replacer to calves in multiple feedings throughout the day. Feeding larger volumes of milk or milk replacer does not require automated calf feeders, but it does favor their use as most automatic calf feeders (ACF) are programmed to deliver a minimum of 20% of body weight as milk or milk replacer, delivered in frequent, small meals spread throughout the day. Consumption of more milk improves pre-weaning average daily gain, which is positively correlated with milk production.^{2,18} Calves offered milk ad libitum typically drink 7 to 12 times/day, a frequency that is very similar to calves nursing a cow.⁴ Calves fed larger volumes of milk or milk replacer have improved digestion and feed efficiency when the frequency of feeding is increased.²³ Increasing the number of milk or

milk replacer meals may also lower risk for the development of abomasal ulcers.¹

The nutrition of preweaned calves fed by ACF is dependent on a number of variables, including volume consumed, nutrient density, milk type and components, group housing dynamics, group size, number and type of feeding stations, and individual calf factors such as calf vigor, immune status, age at introduction to the ACF and adaptation to group housing. With a 10 L or greater milk allowance, competition at the feeder is rarely a problem and the number of unrewarded visits is low until the group size exceeds 24 calves.¹⁰ Computerized ACFs usually deliver milk portions that range between 0.5 and 3 L, with a time lag between meals of 30 to 240 minutes.¹⁹ Increasing meal size and lowering number of visits may lower competition for access to the feeder.¹⁰ Advancing technologies in ACFs offer precision feeding, phase feeding through combination feeders, calf-rail feeders to feed individually housed calves, water meters, feed bunks to measure texturized feed and forage consumption in real time and body scales at the feeding station.¹⁹

Most ACFs can deliver either whole milk or calf milk replacer. The volume fed and the type of milk product used, in part, determine expectations for average daily gain (ADG) (Table 1). Even with the best paper ration, the ACF must deliver the expected ration and the calves consume it for expectations of 1.6 to 2.3 lb (0.73 to 1.04 kg) ADG and performance to be reached.

An important advantage of using an automated feeding system to feed preweaned calves is reduced time for feeding. Estimated at 10 minutes/calf/day for 2 times daily manual milk replacer feeding, it is estimated that 1 minute/calf/day is the labor requirement for feeding calves using an ACF system.¹² Time savings is gained from feeding in an ACF system should be redirected towards regular, frequent monitoring – machine settings, feed delivery, feeding consistency, cleaning, and monitoring of milk/milk replacer and calves.

Nutritional Consistency Prior to and While on the ACF

Regardless of whether the ACF delivers whole milk or milk replacer, an increased milk allowance has a positive effect on calf health and future milk production, provided that the diet is consistent and that digestive tract function is optimal. Digestive tract function of the preweaned calf can be affected by many things, including meal volume, osmolality of the liquid diet, total solids of the liquid diet, caloric content, protein and fat content, pH, abomasal and intestinal motility, water availability, microbial flora, inflammation, and infection. Inconsistencies in timing of meals, temperature of the liquid, presence of feed additives, total solids of the milk product delivered at the nipple, nipple height, or mineral and vitamin content can have a significant impact on calf health and performance, even in ACF systems. ACF equipment performance and cleanliness must be monitored on a regular basis. When milk replacer is fed in ACFs, there should be less

than a 1 to 2% difference between the expected (gm/L) milk concentration, the concentration of the milk replacer in the mixer, and the concentration of the milk replacer delivered through the nipple. Mixer and circuit cleaning frequency, feeding and mixer hose replacement, and nipple height may affect this. Whole milk total solids should also be consistent throughout the ACF system.

Prior to being introduced to the ACF, milk or milk replacer consistency is similarly important and accomplished by preparing milk replacer meals using weight rather than volume measurements, having the appropriate temperature of water at the time of milk replacer mixing, having water weight or volume consistent from 1 feeding to the next, keeping the milk replacer solution agitated through the entire delivery process, and having clean mixing, delivery, and feeding equipment.

Monitoring nutritional consistency between calves, between feedings and between parts of the ACF system is accomplished by monitoring calf weights, calf health parameters, and taking Brix readings. For whole milk, it has been estimated that the Brix reading can be converted to estimated total solids percentage by using a calculated standard curve equation derived from spectrophotometric results: $y=0.9984x + 2.077$.¹⁶ For milk replacer solutions, the Brix reading must be related to the total solids percentage by making a standard curve equation using a known set of milk replacer concentrations between 8 and 18%. Every milk replacer yields a unique standard curve equation. Once the relationship between the Brix reading and the milk replacer concentration total solids has been established, reliable trending can be performed using frequent Brix reading testing. Samples (milk or milk replacer) for Brix readings can be stored up to 7 days at room temperature, refrigerated or frozen.⁸ Total solids percentage greater than 18% and less than 12% should be avoided and more than a 1 to 2% change between feedings may create a risk for ulcers, bloat, abomasitis, abomasal tympany, intermittent appetite, abnormal manure, or clostridial problems.

Table 1. NRC comparisons of whole milk and milk replacer diets for a 100 lb Holstein calf, consuming 0.5 lb of an 18% CP calf starter at 65°F.

Whole milk	5 L/day	10 L/day
Energy allowable ADG	1.63 lb/day	3.52 lb/day
ADP allowable gain	1.35 lb/day	2.75 lb/day
Growth limiting nutrient	Protein	Protein
Crude protein balance	-34 gm /day	-90 gm/day
20:20 milk replacer	5 L/day	10 L/day
Energy allowable ADG	1.51 lb/day	3.33 lb/day
ADP allowable gain	1.12 lb/day	2.30 lb/day
Growth limiting nutrient	Protein	Protein
Crude protein balance	-48 gm/day	-122 gm/day

Where ADG=average daily gain; ADP=apparently digested protein

Bacterial counts can be used to assess milk and milk replacer quality of the calf diet, especially in ACF systems where variability in mixer and circuit cleaning frequency and effectiveness may be noted, where feeding hose, mixer hose or nipple sanitation and replacement frequency may not be ideal, or the presence of biofilms may prevent adequate sanitation. Feed contamination can be a source of pathogen or toxin exposure for calves.

Cross Sucking

Non-nutritive sucking directed to the body parts of another calf, a problem referred to as cross sucking, commonly occurs amongst group-housed calves fed from ACFs. Non-nutritive sucking directed towards parts of the calf pen and intersucking, when calves suck the udder of another calf, are also frequently observed in this environment. Because these behaviors can lead to unwanted consequences like hair loss, inflammation, teat or udder injury, mastitis, decreased milk production or persistence into adulthood, preventive measures are warranted. Effective control measures include feeding more milk, prolonging meal duration to a minimum of 10 to 15 minutes by reducing milk flow, using nipples with a smaller orifice (4 mm vs 6 mm), having protected feeding stalls or reducing group size. Some reduce cross sucking by feeding water through a teat or nipple. Providing access to high energy, high quality solid feed at all times and implementation of a programmed, gradual weaning process will also reduce cross sucking behaviors.

Weaning Strategy

When larger amounts of milk are fed to calves, less starter is consumed pre-weaning and, unless a gradual milk step-down procedure is implemented, post weaning growth depression and increased cross sucking may be observed.^{9,17} Automated feeding systems that provide calves the opportunity to make multiple rewarded feeding visits during the day offer the flexibility to deliver a gradual step-down, programmed weaning process. ACF systems can be used to implement a number of automatically controlled weaning steps, increasing the duration of weaning. In ACF systems, delayed weaning is common, thus reducing the drop in energy intake, number of unrewarded visits to the feeder, and other unwanted weaning behaviors.⁵ In a recent producer survey of ACF systems in the midwest, 73% of producers reported that calves were consuming 3 to 5 lb (1.36 to 2.27 kg) of starter at the average weaning age for heifers of 7 weeks.³

Screening for Disease and Growth

Most automated calf feeding systems are introduced into group housing settings. While it has been reported that disease and mortality rates amongst calves raised in small groups can mimic those reported when calves are raised in

individual pens,¹³ increased morbidity is common in pre-weaned calf group housing. Raised in groups, calf contact, shared nipples, cross sucking, communal bedding, and shared aerosol are among the risk factors that can increase exposure to the organisms that cause diarrhea and respiratory disease, especially in calf group sizes greater than 6 to 9.²⁰ Of particular concern are group-housed calves with failure of passive transfer (FPT) because they shed more organisms in bodily secretions (urine, feces, saliva, nasal and ocular discharge), thus augmenting environmental exposure to potential pathogens amongst commingled calves. In larger groups and in calf pens that are continuously occupied, both the number and survival of environmental organisms increase, conditions that almost always increase calf morbidity and mortality.

With a recognized risk of increased disease morbidity in calves fed by ACFs in group housing, disease detection is a critical part of management. Early recognition of diarrhea, respiratory disease, umbilical and joint problems, and effective treatment will curtail but not eliminate horizontal transmission amongst commingled peer calves, but disease detection can be very challenging. While many dairies rely on ACF computerized data output for disease detection by establishing preset alarms, the sensitivity of finding a change in milk intake (reduced intake, reduced visits, slow drinking) or an increased number of unrewarded visits has been questioned.²¹ Undoubtedly technologic advancements will result in improved methods that can be used for disease detection and enhanced automated output data that will improve disease detection sensitivity. Until that time, it is suggested that a regular in-pen health screening process be implemented at least twice weekly.¹⁵ In-pen health screening tools (Calf Health Scorer and Group Pen Respiratory Scorer iTunes store apps) are designed to look at all calves in a pen, not just the selective calves found as outliers by the ACF computer. In addition to the twice-weekly in-pen health screening, a trained individual should be assigned the daily chore of performing a complete exam on any individual calves identified by the ACF computer as being abnormal. A complete exam includes rectal temperature, appearance of eyes, ears, nose, manure, navel and joints (Calf Health Scorer app). Treatment protocols for respiratory disease, scours, umbilical and joint infections are established by a veterinarian with a valid VCPR, and given to individuals trained to effectively implement the plan. Efficacy is dynamic and requires regular monitoring by management and the veterinarian for consistency, compliance, and record-keeping. Most autofeeders allow for targeted provision of medication to sick calves through a medicator, but parenteral treatments and diagnostic testing require protocols, training, and equipment for stress-free handling and restraint of calves.

Monitoring and Oversight

Group housing and feeding calves can reduce the labor needed for feeding calves and more easily allows for feeding a

higher plane of nutrition. However, the labor saved on feeding must be redistributed to monitoring several of the factors previously mentioned. Regardless of when calves are introduced to the ACF, follow-up should be implemented to ensure that consumption is appropriate and that calves are not losing weight. Software can track consumption, visits (rewarded and non-rewarded), drinking speed, break-offs, and alarms are built in to help identify calves with low consumption or slow drinking speeds. Calves not consuming their allotment may be indicative of poor transition, disease, or over-crowding. Milk and/or replacer quality should be regularly checked.

Conclusion

In conclusion, while it is possible to raise calves using indoor, group-feeding strategies, special care must be taken to consider the aforementioned factors. Incorporating proactive oversight will ensure that these young calves develop into high quality dairy cattle.

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