Creep Feeding Nursing Beef Calves

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In beef cattle management systems, supplementation of nursing, grazing calves before weaning is referred to commonly as “creep feeding.” Using specially designed feed bunks or fencing, calves are offered feedstuffs that their dams cannot access. Creep feeding is a management tool used to increase weaning weights\textsuperscript{1} and, presumably, gross income for beef producers who market their calves at, or shortly after, weaning. Creep feeding has also been used to alleviate nutrient deficiencies associated with drought conditions or other forage shortages\textsuperscript{1}, and to acclimate calves to consumption of processed feeds before weaning. Research trials examining these aspects of, and the economic returns associated with, creep feeding have produced mixed results. Therefore, the decision to creep feed should be considered carefully by beef cattle producers on a year-to-year basis.

The purpose of this article is to review the available scientific literature in the area of creep feeding, including the types of creep feeds; the rationale for creep feeding; and the effects of creep feeding on a number of variables, including nutritional status, growth, performance, and carcass characteristics. In addition, the article indicates areas in the literature where data are lacking or need further refinement, and gives general recommendations on how to manage a creep-feeding program.

Types of creep feeds

Creep feeds vary by type and formulation. Most can be placed into one of three broad classifications: energy-based creep feeds; limit-fed, protein-based creep feeds; and forage-based creep feeds (ie, creep grazing)\textsuperscript{2}. 

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0749-0720/07/$ - see front matter © 2007 Elsevier Inc. All rights reserved. doi:10.1016/j.cvfa.2006.11.002

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Energy-based creep feeds typically contain 12% to 18% crude protein (CP; dry matter [DM] basis) and generally are offered free choice. Energy-based creep feeds are designed to replace or supplement lesser-energy forages in the diet of nursing calves. These feeds are generally the most widely available type of creep feed used in beef production systems throughout the United States [3]. Within energy-based creep feeds, the two sub-categories are high-starch creep feeds and high-fiber creep feeds. High-starch creep feeds are based on cereal grains, with corn and oats being used widely. These feeds are higher in starch and digestible energy, and lower in neutral detergent fiber and acid detergent fiber, than other creep feeds. High-fiber creep feeds are generally lower in starch and digestible energy, and higher in neutral detergent fiber and acid detergent fiber than creep feeds based on cereal grains. Usually, high-fiber creep feeds are based on grain-milling or oilseed-crushing byproducts, such as wheat middlings or soybean hulls.

Limit-fed, high-protein creep feeds are the second major class of creep feeds [2]. These contain greater levels of CP and lower levels of starch than energy-based creep feeds. Like high-fiber creep feeds, protein-based creep feeds are usually made from grain-milling or oilseed-crushing byproducts. Generally speaking, limit-fed, high-protein creep feeds contain at least 25% CP, but this may vary depending on the CP content of the feeds used in formulations. By design, limit-fed, high-protein creep feeds might contain some sort of intake limiter in the formulation, as a means to hold intake to a targeted level. A common intake limiter is salt (typically 10%–15%, DM basis), but other chemical limiters or ingredients may be use in specific formulations. Another method to limit consumption of protein-based creep feeds is to deliver them in the form of blocks. Blocks use physical hardness, chemical limiters, or deliquescence to limit consumption to desired levels [4]. Limit-fed, high-protein creep feeds are usually designed to enhance the use of poor-quality forages. They can produce weight gains similar to free-choice feeds; moreover, they produce gains more efficiently (calculated as additional weight gain per unit of creep feed consumed) than free-choice creep feeds, because intake is restricted.

Forage-based creep feeds are the third major class of creep feeds. Forage-based creep feeding is often referred to as creep grazing [1,2,5,6]. In this creep feeding system, calves, but not cows, are given access to high-quality pasture, forage, or range, through specialized fencing or other methods. This practice is not common in much of North America, but is useful in situations where access to high-quality annual forages is common. Creep grazing has been used with some success in the southern Great Plains [1], where producers have access to high-quality, small grain pastures.

**Nutrient requirements of the nursing calf**

Unlike most other classes of beef cattle, the nutritional needs of grazing, nursing beef calves are defined poorly. In particular, the intake, ruminal
function and development, and digestion of nursing beef calves have received limited attention in the scientific literature. Most of what is known regarding preweaning nutrition applies to forage, milk, and creep feed intake [7–9]. The effects of creep feeding on ruminal metabolism and fermentation have also been described [10–13].

Some researchers have focused on creep feeding as a means to alleviate nutrient deficiencies in the basal forage to which calves have access. In these cases, regional differences in first-limiting nutrients were noted. Calves grazing subirrigated meadow regrowth [7] or native range [8] in the sandhills of Nebraska were limited by metabolizable protein intake. Conversely, energy was the first-limiting nutrient in the diets of calves grazing native range in southeastern North Dakota. These calves did not respond to an increased supply of undegradable or escape protein [9]. The reasons for this discrepancy are not immediately apparent, but likely result from differences in forage species, grazing season, or other factors impacting the metabolizable protein supply of the grazing calf.

**Intake**

Nutrient intake is affected by calf age, weight, and genetics, and by environmental factors. Milk is the primary source of nutrients until approximately 90 days of age [14]. Calves older than 90 days can meet most of their nutritional requirements from forages, provided that forage quality is adequate. Milk production and milk intake are affected by a number of factors, including breed [15,16], nutritional status [17], parity [15,17], and calving season [5,6]. The relationship between milk intake and milk production is dynamic. Cows will adjust milk production to calf needs as long as these demands don’t exceed the capacity of the cow to produce milk [18]. Peak milk production likely occurs somewhere between 30 [19] and 56 days [20] postpartum, and declines throughout the remainder of lactation.

As milk production declines, forage becomes increasingly important as a source of nutrients for beef calves [8,21]. Unfortunately, in most beef production systems in the United States, forage quality declines at the same time that the cow’s milk production declines [22]. Although calves are able to select higher quality forages than their dams [10,23,24], forage quality and milk production can be reduced to the point where calves are not able to express genetic potential for growth. In these cases, creep feeding may be a useful means of delivering supplemental nutrients to the nursing calf.

It is important to remember that creep feeds replace forage, not milk, in the diets of nursing calves [25,26]. In general, consumption of high-starch creep feed decreases forage organic matter (OM) intake, whereas milk OM intake is unaffected [27]. In most cases, total OM intake (ie, creep OM + forage OM + milk OM) by supplemented calves does not increase over that by unsupplemented cattle when high-starch creep feeds are offered.
Conversely, creep feeds based on digestible fiber sources and limited, protein-based creep feeds have little effect on forage OM intake [11,12,25], and usually result in increased total OM intake [12,25].

Ruminal fermentation characteristics

Ruminal degradability of feedstuffs is influenced by various factors, including DM intake, ruminal pH, passage rate, and microbial efficiency [28]. These factors, in turn, depend heavily on the types and compositions of feedstuffs consumed [20].

High-starch creep feeds have been shown to decrease ruminal pH [13,25,27], whereas fiber-based creep feeds did not affect ruminal pH [11,12]. Regardless of creep-feed type, researchers have reported greater ruminal volatile fatty acid concentrations in supplemented calves, compared with unsupplemented calves [13,25–27]; however, this was not true in all cases [29]. Creep feeds based on soybean hulls and wheat middlings markedly increased ruminal ammonia concentrations [11,12], as did creep feed that contained high levels of field peas [13]. In contrast, corn-based creep feeds resulted in reduced ruminal ammonia concentrations [25,27]. Microbial efficiency in calves fed a high-fiber creep was similar to that in unsupplemented calves [11,12]. Creep feeding increased total tract OM digestion, as a percentage of intake [11,12]. This effect was expected, given the greater digestibility of most creep feeds relative to that of the basal forage.

Diet selectivity

Research into the effects of creep feeding on diet selection by grazing calves is limited. In general, creep feeding does not change the chemical composition of diets selected by grazing calves [12,29]; however, calves fed a wheat middling- and field peas-based creep feed selected diets higher in CP than unsupplemented calves [13]. It was not immediately apparent why such differences existed, but they may have been related to differences in basal forage quality, forage intake, or other variables.

Duodenal nutrient supply

Little research has investigated the effects of creep feeding on the duodenal nutrient supply of nursing calves. In some cases, the supply of nutrients improved with the provision of creep feed. For example, bacterial nitrogen supply to the duodenum improved with the provision of a creep feed based on wheat middlings and soybean hulls [12]. Conversely, no differences in duodenal supply of nutrients were noted when different creep feed formulations were compared [29]. In this study, one supplement formulation was 41% soybean meal, 26.25% wheat middlings, 26.25% soybean hulls, 5% molasses, and 1.5% limestone, and the other formulation was 50% corn.
distillers grains, 14.25% wheat middlings, 14.25% soybean hulls, 14% soybean meal, 5% molasses, and 1.5% limestone [29].

Performance of calves

Preweaning performance of calves

Most often, creep feeding is used to increase weaning weights [5,25]; however, changes in average daily gain associated with creep feeding are variable [30]. A summary of selected university research trials [1] indicated that grazing, nonsupplemented, nursing calves averaged 0.65 kg of gain per day during the last 152 days of lactation. Their contemporaries supplemented with free-choice, energy-based creep feed gained 0.83 kg per day and were 26.4 kg heavier at 200 days of age (ie, weaning). In this research summary, supplemented calves consumed an average of 1.6 kg of energy-based creep feed per day. Supplemental gain efficiency, calculated as additional gain per unit of feed consumed, was 0.11 across all trials evaluated in the summary.

Calves offered limit-fed, high-protein creep feeds generally achieved gains similar to those of calves consuming energy-based creep feeds; however, they consumed less feed and were more efficient at converting creep feed into gain [25,31,32]. Calves offered limit-fed protein creep feeds can achieve supplemental gain efficiencies between 0.22 and 0.35 kg of gain per kilogram of creep feed intake [1,31].

Creep feeding has also resulted in calves that have greater body fat percentages [5,6], increased height at the withers [5,6], and greater USDA feeder calf grades [6]. These variables likely have little, if any, measurable economic consequence, particularly if calves are sold directly after weaning; however, they indicate that increasing the supply of nutrients through creep feeding can result in increased growth. The greater body fat percentage [5,6] associated with creep feeding may have carry-over effects on the carcass quality of the mature animal.

Preweaning performance of dams

Some researchers have suggested that creep feeding decreases nutrient requirements associated with lactation and, as such, can improve conception rates [5] and reduce the postpartum interval [1]. This is probably not the case. Creep feeds tend to replace forage, and not milk, in the diets of calves. Most investigators reported similar cow performance, regardless of whether their suckling offspring were provided with creep feed or not [31,33,34].

Postweaning performance and carcass traits

Anecdotal evidence has been interpreted to suggest that creep-fed calves achieve the transition to feedlot diets with less stress and less sickness than unsupplemented calves [1,35]. Feedlot performance among creep-fed calves is
variable, and may be related to postweaning management. Calves offered free-choice, energy-based creep feeds and placed on growing diets (>1 kg/day gain) after weaning produce daily gains and gain efficiencies that are less than that of unsupplemented calves [25,27]. Conversely, creep-fed calves that are placed on backgrounding rations (<1 kg/day gain) after weaning respond with gains and gain efficiencies similar to those of unsupplemented calves [1]. Creep-fed calves that are placed directly into the feedlot after weaning tend to perform equal to, or slightly less than, calves not offered creep feed [25,27,33].

The effects of creep feeding on meat quality and yield have not been investigated thoroughly. The limited research indicates that creep feeding may have impacts on the carcass quality of the mature animal [25]. In the northern Great Plains, the carcasses of calves offered fiber-based creep feed (ie, soybean hulls and wheat middlings) had marbling scores similar to the carcasses of nonsupplemented controls [33]. Creep feeding does not seem to affect the components of red meat yield or USDA yield grade, regardless of feed ingredients or intake [25,27,33].

*Replacement heifers*

Few studies have explored the effects of creep feeding on the development and lifetime production of replacement heifers. Mature cows that were creep fed as calves had lower initial milk production, lower lifetime milk production, lighter calves at weaning, and fewer calves over a lifetime than cows not creep fed as calves [3,36]. Cows that were creep fed as calves had mature weights similar to those of their nonsupplemented contemporaries [34].

*Designing effective creep feed supplements*

Designing an effective creep-feeding program calls for knowledge of forage quality, forage intake, and calf nutrient requirements. Creep-feed supplements should be used to overcome a nutrient deficiency in the calf’s diet while maintaining or enhancing ruminal fermentation and digestion of the basal components of the diet (ie, forage and milk). This process is difficult and, in many cases, is more of an art than a science. Future research into creep feeding should focus on defining the factors that influence nutrient supply, ruminal fermentation, total tract diet digestion, subsequent feedlot performance, and subsequent carcass characteristics of the suckling calf.

*Summary*

Creep feeding can be used to increase calf weaning weights. However, the gain efficiency of free-choice, energy-based creep feeds is relatively poor. Generally, limit-feeding, high-protein creep feeds are more efficient, and gains may be similar to those produced by creep feeds offered free choice.
Creep feeding can increase total OM intake and, therefore, has the potential to improve the overall energy status of the animal. Creep-fed calves tend to acclimate to the feedlot more smoothly than unsupplemented calves. Furthermore, provision of a high-starch creep feed may have a positive influence on subsequent carcass quality traits. Creep feeding can be applied to numerous environmental situations to maximize calf performance; however, the beef cattle producer should consider his/her individual situation carefully as it relates to production goals, cost of production, and feed resources before making the decision to creep feed.

References


