# 17 Supplementing and Feeding Calves and Stocker Cattle

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## Objectives

- Define supplementation and substitution
- Discuss winter supplementation strategies
- Discuss summer supplementation strategies
- Explore various substitute feeding programs

The stocker industry is an important economic enterprise in Oklahoma because of the abundant forage resources that can be utilized to put low-cost weight gain on cattle. In addition, an abundant supply of oilseed meals, cereal grains, silages, and grain milling byproducts are produced in the Midwest and High Plains. These feed resources can be used in growing programs as a major portion of the diet or used as supplements to enhance the performance of grazing cattle. Because of the numerous options available and variables involved, producers that do a good job of tailoring their supplementation or feeding program to fit their situation are much more likely to be profitable compared to producers that do not.

A list of commonly available feedstuffs is provided in Table 12.1 (page 115). Becoming knowledgeable of feed nutrient values is important, particularly if the producers intend to purchase feed commodities or mix their own feed. Computer software programs, such as OSUNRC2002, aid in rapid calculation of growing rations and supplements for beef cattle. This software can be accessed at http://www.ansi.okstate.edu/software/, and it computes nutrient requirements including protein, energy, macro and trace minerals, and compares ration content with animal requirements.

It is important to be aware that the nutrient values listed in Table 12.1 are averages and that energy values apply to mixed roughage and concentrate diets formulated for moderate rates of growth. These values are based on data from the National Research Council and other sources. Unfortunately, energy values for many feeds change, as the amount in the diet changes. This issue is commonly referred to as associative effects.

## Supplementation and Forage Substitution

Even though forage is the least expensive feed resource for cattle, there are times when the nutritive value of forage is not sufficient to meet the animal's dietary requirements. In these cases, supplementation of the deficient nutrient or nutrients will usually increase forage intake and digestibility, improve health status, and/or maintain a higher level of productivity. When the provision of one or more nutrients in the form of a supplement increases forage intake and digestibility, the supplement is said to have a positive associative effect on forage utilization (Figure 17.1). Supplementation can also result in no change in forage intake and digestibility, with the end result being greater total nutrient intake (Figure 17.1).

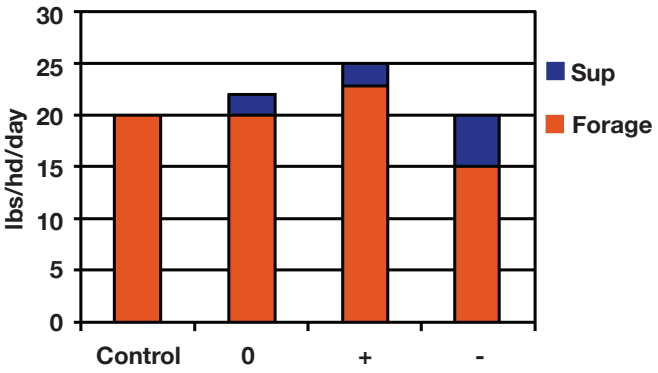


**Figure 17.1 – Influence of supplemental feed on forage intake (lbs/hd/day); positive (+) or negative (-) associative effects.**

On the other hand, there are times when forage supply is not adequate to sustain the number of animals grazing a land area for a given time period. When forage is limited, forage dry matter intake declines in accordance to the extent of the limitation and the quality of the remaining forage. As a result, animal performance frequently declines when forage availability is significantly limited. One unfortunate (although frequently observed) example is thin cows being maintained in an overgrazed pasture. During times of drought or necessary short-term overstocking, some ranchers choose to replace forage with other feed resources. This practice is referred to as substitution or substitute feeding. The objective can be two-fold: limit or eliminate the potential decline in animal performance due to a shortage of forage, or reduce the rate and/or extent of forage disappearance in order to maintain a higher stocking rate. This objective is also referred to as stretching the forage with feed. Substitution can have a negative associative effect on forage utilization because

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forage intake is reduced and, in certain cases, forage digestibility may be reduced (Figure 17.1). Total nutrient intake by the animal may not change, or it may slightly increase, resulting in improved animal performance.

The distinction between supplementation and substitution, regarding the amount of feed provided, is not well defined for cows or growing calves. However, most studies indicate that forage intake declines when more than 0.5% of body weight supplemental feed is provided. The substitution rate (decline in forage intake) is variable and depends on the amount of feed provided, protein concentration of both the base forage and the feed, and the type of supplemental feed being provided. In general, each pound of additional feed beyond the 0.5% of body weight rule of thumb can reduce forage intake by 0.5 to 2 lbs. The substitution rate and negative associative effects are greater when feed grains are fed in combination with low quality forage with inadequate supply of ruminally degradable protein. An example of how to calculate the degradable protein requirement is provided later in this chapter.

## Supplements for Forage-Based Growing Programs During Winter

Stocker cattle are often purchased ahead of the period when high quality forage, such as spring grass or wheat pasture, will be available. Many of these holding/growing programs are based on moderate- to low-quality forages and roughages, such as grass hay and stockpiled native range, Bermudagrass, or cool-season perennial pasture. This approach allows producers to take advantage of seasonal stocker cattle availability and market trends. If hay or standing forage is available, the normal strategy is to target gains at a rate that at least covers daily cash and overhead costs, but does not reduce subsequent performance when cattle graze high quality forage or when they are placed in the feed yard. Target weight gains between 0.5 and 1.5 lbs per day are common.

Supplements for this situation should achieve one or more of the following:

- Supply protein to enhance roughage intake and digestion (for roughages that do not meet protein requirements)
- Supply additional energy above that obtained from the roughage; this is critical with lightweight calves (under 350 lbs)
- Supply other important items in the diet such as vitamins, minerals, and additives (ionophores, coccidiostats, and antibiotics)

Protein requirements vary depending on animal age, weight, and rate of gain. For example, a 450-lb steer gaining 1 lb per day requires approximately 10% crude protein on a dry matter (DM) basis. A 450-lb steer gaining 2 lbs per day requires approximately 12% DM protein. Consequently, the appropriate amount of total protein in the diet and, therefore, the correct protein concentration in the supplement, depends on the target gain and the amount of energy available in the diet.

Dormant native range is almost always low in protein; between 3 and 5% DM. Standing Bermudagrass forage is more variable, depending on forage quality at the end of the growing season and the amount of deterioration from rainfall. If forage quality was high at the time of first frost, protein concentration above 8% through the month of January is not uncommon. However, if Bermudagrass forage was more mature at the time of first frost and significant rainfall occurs during late fall and early winter, protein content will likely be low and comparable to native winter range. Similarly, cool season grass hay protein concentration is extremely variable and depends on maturity at harvest, species, fertilization program, and harvest conditions. A typical range for protein concentration is 6 to 14% for Bermudagrass hay and 4 to 8% for prairie hay. The only way to be sure of nutrient concentration and the most appropriate supplementation program is to have hay samples analyzed for nutrient content by a commercial laboratory. See OSU Extension Fact Sheet PSS-2589 and PSS-2117 for more information regarding hay testing and analysis interpretation.

To maximize forage intake and digestion, protein requirements must be met. Energy supplementation will not be effective if protein is deficient. Table 17.1 gives general guidelines for the amount of supplemental protein needed, based on forage protein content and expected rate of gain. The first step is to choose the expected rate of weight gain from the table—0.5, 1.0, or 1.5 lbs per day. The next step would be to choose the column with the forage protein concentration closest to the forage protein concentration in your situation—4, 6, 8, or 10%. The value in the table where the appropriate line and column intersects represents the approximate amount of protein that needs to be supplied on a daily basis in your situation. This value represents the supplemental protein need. In order to determine the amount of actual supplement that would need to be provided, divide the supplemental need by the protein concentration (as-fed basis) of the supplement. For example, a 400-lb steer receiving prairie hay containing 6% crude protein needs 0.6 lb of supplemental protein in order to gain 1 lb per day. If the supplement contains 20% crude protein on an as-fed basis, 3 lbs would need to be fed (0.6 ÷ 0.2 = 3). A supplemental protein requirement is not indicated for 1.5 lbs per day gain with forages containing less than 6% crude protein,

**Table 17.1 – Supplemental protein required (lbs per day) for 300- to 500-lb stockers with varying protein content in forage grass hay[a].**

| Daily gain, lbs | Forage crude protein content (DM basis) | | | |
|---|---|---|---|---|
| | 4% | 6% | 8% | 10% |
| 0.5 | 0.60 | 0.4 | 0.25 | 0.10 |
| 1.0 | 0.75 | 0.6 | 0.45 | 0.25 |
| 1.5 | - | 0.8 | 0.65 | 0.50 |

a Calculated using equations from NRC.

simply because this level of gain with extremely low quality forage is not practical.

Once the protein requirement has been met, weight gain is usually limited by energy availability. Therefore, producers may choose to feed additional supplemental energy to further increase animal performance. As mentioned above, feeding up to around 0.5% of body weight total supplement has a high probability of ensuring maximum forage utilization. Beyond that threshold, particularly for low quality forage, forage intake may decline resulting in a substitution or feeding situation rather than a supplementation situation. Given a situation dealing with 500-lb calves and an overall goal of maintaining maximum forage utilization, the upper limit for the amount of supplement would be 2.5 lbs per day. From Table 17.1, if we assume forage providing 8% protein and available energy to support 1 lb per day gain, about 0.45 lb of supplemental protein is required. This need could be met by feeding 1 lb per day of a 40% protein supplement. On the other hand, by feeding 2.5 lbs of supplement, weight gain may be increased by 0.2 to 0.3 lb per day. Increased weight gain results in increased daily protein requirement. Reading between the lines in Table 17.1, the daily supplemental protein requirement for 1.25 lbs per day gain (8% protein forage) would be about 0.55 lb. Therefore the supplement would need to contain approximately 22% protein ((0.55 / 2.5) x 100). Commercial feed companies provide supplements containing a wide range of protein concentration to fit specific situations, such as the one described in this example.

The final objective of a supplement for grazing cattle is to deliver other nutrients or feed additives, such as vitamins, minerals, ionophores, antibiotics, or coccidiostats. Chapter 14 discussed in detail vitamin and mineral nutrition for grazing cattle, so consequently, those concepts will not be dealt with here. However, it should be mentioned that most ingredients included in protein and energy supplements contain substantial amounts of minerals. For example, most feed grains and grain milling byproducts contain high concentrations of phosphorus and very little calcium, while alfalfa and other legume forage resources contain high concentrations of calcium. Few feeds, other than green forage, contain substantial amounts of vitamins. Therefore, total dietary vitamin and mineral supply should be calculated and evaluated any time a supplementation or feeding program is being considered.

## Supplementing Late-summer Pasture

Winter supplementation concepts apply to late-summer pasture grazing situations. Native range, Bermudagrass, and cool-season perennial pasture forage quality rapidly declines during mid-summer. As a consequence, stocker cattle gains can fall from performance highs of 2 to 3 lbs per day during spring and early summer, to below 1 lb per day through the late summer grazing period. As Figure 17.2 indicates, protein concentration in native range forage rapidly declines after May. The result is realized in summer weight gains of around 1 lb per day.

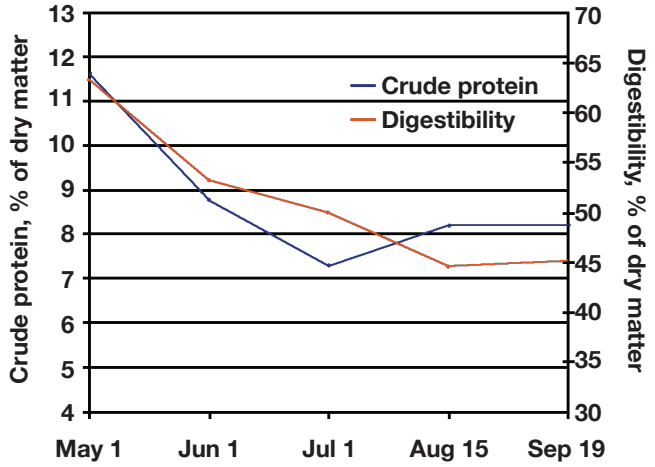


**Figure 17.2 – Protein and digestibility of native range forage during summer (2-year trial summary). Source: Bogle, Engle, and McCollum.**

In several trials conducted at OSU with prairie hay harvested in mid-summer, forage intake was increased by 20% to 30% and digestibility was improved by 15% to 20% when cattle were supplemented with 1 lb of a 38% to 41% protein supplement. This improvement in forage utilization for hay-fed cattle also applies to stocker cattle grazing summer pastures.

Logically, this assumes that forage availability is adequate. A small quantity of high protein supplement will not improve weight gain if pastures are overgrazed. Table 17.2 summarizes research trials in which weight gain of nonsupplemented calves was compared to weight gain of calves supplemented with 0.9 to 1.2 lbs per day of 38% to 41% protein feed.

In seven research trials conducted with late-summer native or mature Bermudagrass pasture, cattle supplemented 0.9 to 1.2 lbs per day of a similar protein supplement gained an average of 0.38 lb per day faster than nonsupplemented cattle. This efficient response to supplement provided the basis for the development of the Oklahoma Gold and Super Gold supplementation programs. The Oklahoma Gold program consists of feeding the equivalent of 1 lb/hd/day of a 37% to 40% all natural protein supplement containing vitamin A, added trace minerals, and one of four feed additive alternatives: Bovatec®, Rumensin®, Gainpro®, or chlortetracycline. Numerous other studies indicate that when grazing cattle receive one of these feed additives, the weight gain response ranges from 0.13 to 0.28 lb per day. Adding an average response of 0.2 to the 0.38 lb from the protein results in an average increased weight gain of 0.57 lb per day. Therefore, the average supplement conversion calculates to 1.8 lbs of feed per pound of added weight gain. These supplementation programs would also be appropriate for calves grazing

**Table 17.2 – Summary of trials evaluating response of grazing cattle to protein supplement[a].**

| Initiation date | Trial length, days | Initial cattle weight | Control ADG, lbs | Supplement ADG, lbs | Added gain, lbs/day | Supplement conversion, lb sup/lb added gain | OSU Animal Science Research Report Reference |
|---|---|---|---|---|---|---|---|
| 7/16 | 96 | 580 | 1.44 | 1.88 | 0.44 | 1.8 | MP - 112, 1982 |
| 7/20 | 56 | 350 | 1.35 | 1.72 | 0.37 | 2.2 | MP - 114, 1983 |
| 7/20 | 62 | 616 | 1.06 | 1.39 | 0.33 | 3.2 | MP - 117, 1985 |
| 8/16 | 56 | 490 | 0.83 | 1.32 | 0.49 | 2.0 | MP - 117, 1985 |
| 8/16[b] | 57 | 440 | 0.95 | 1.25 | 0.30 | 3.3 | MP - 117, 1985 |
| 7/16 | 84 | 645 | 0.83 | 1.25 | 0.42 | 2.9 | MP - 118, 1986 |
| 5/25 | 84 | 365 | 1.48 | 1.75 | 0.27 | 3.7 | P - 939, 1994 |
| 7/28 | 84 | 622 | 1 | 1.5 | 0.5 | 2 | P - 1014 |
| 7/16 | 68 | 699 | 1.33 | 1.59 | 0.26 | 3.8 | P - 1014 |
| Average | 72 | 531 | 1.14 | 1.52 | 0.38 | 2.77 | |

a Supplement amount ranged from 0.9 to 1.2 lbs per day and contained 38 to 41% crude protein on a dry matter basis. All supplements were formulated with soybean meal and/or cottonseed meal as the protein source.
b Forage base was Bermudagrass pasture. All other studies utilized native range pastures.

mature Bermudagrass pasture. However, calves grazing mature native grass pasture during this time of the year can be expected to gain faster compared to cattle grazing mature Bermudagrass pasture.

Super Gold feed contains 25% protein and should be fed at the rate of 2.5 lbs per day. Much like Gold, the Super Gold feed product supplies supplemental protein, vitamins, minerals, and a feed additive. With this program, weight gains have been improved an average of 0.76 lb/hd/day when cattle graze abundant native grass pastures during late-summer or early-fall. This is an average supplement conversion efficiency of 3.3 lbs of feed per pound of added weight gain.

These supplementation programs were specifically designed for growing cattle grazing abundant native pasture during late summer and early fall. Because these supplements are provided in relatively small amounts, they can be fed daily or on an every-other-day basis.

Adequate forage is a necessity to make these supplementation programs successful because they are designed to enhance forage intake and digestion. They are NOT designed to stretch pasture or increase stocking rate.

Table 17.3 shows typical formulations for Oklahoma Gold and Super Gold feeds. Similar results should be attainable with free-choice supplements designed to deliver approximately the same amount of degradable protein, minerals, and the feed additive. Examples of these small-package supplement delivery systems include pressed and cooked block products as well as liquid feed products. Some of these products will contain at least some nonprotein nitrogen. While nonprotein nitrogen can be used effectively by grazing cattle under certain conditions (see Chapter 16), a high percentage of nitrogen (protein) from plant sources will likely give better results in this situation, compared to a feed product containing a high proportion of nonprotein nitrogen.

A mid-protein, high energy supplement, similar to the Super Gold formulation, is the better choice in situations where feed prices are moderate to low, or a faster rate of gain is necessary to achieve a predetermined market weight.

**Table 17.3 – Typical formula for Oklahoma Gold and Oklahoma Super Gold feeds.**

| Ingredient | Composition, % (as fed basis) | |
|---|---|---|
| | Oklahoma Gold | Oklahoma Super Gold |
| Cottonseed meal | 86.0 | 17.0 |
| Soybean meal | - | 15.0 |
| Wheat middlings | 7.0 | 56.0 |
| Molasses (pellet binder) | 4.0 | 4.0 |
| Vitamin and mineral premix | 3.0 | 3.0 |
| Feed additive | Variable | Variable |
| Crude protein, % as fed | 38.0 | 25.0 |
| Feeding rate, lbs per day | 1.0 | 2.5 |

## Beyond Supplementation—Feeding Programs

In many farm situations and during some years, the high quality pasture alternative may not be available. In these cases, hay coupled with supplementation or concentrate-feeding programs can be implemented. The number of nutrition program alternatives is virtually unlimited.

Energy from grain is primarily in the form of starch or nonstructural carbohydrate. The majority of forage energy is in the form of fiber or structural carbohydrate. When a small amount of starch-based energy supplement is fed (0.25% of body weight or less), forage intake and digestibility are either not affected or slightly improved. This assumes that forage protein concentration is adequate to meet the degradable protein requirement. However, when grain is supplemented at higher levels and protein concentration in the diet is marginal or deficient, forage intake and digestibility generally decline. This is why feed grains are not thought of as being ideal supplements for cattle that are receiving a low quality forage diet. For one thing, pellet quality declines rapidly as the amount of grain in the formula increases. In addition, many ranchers prefer to use three-quarter-inch pellets or cubes so that cattle can be fed on the ground with minimal waste. Unfortunately, larger pellet size is associated with lower pellet quality

when a significant amount of feed grain or any feed with poor binding characteristics is included in the formula. Cattle receiving low quality roughage diets make better use of feed grains if they are coarsely rolled or cracked. Consequently, feed formulas with high grain content are usually fed in bunks to minimize waste.

Feed grains are primarily used to provide energy to cattle because grains are energy rich and moderate to low in protein concentration (8 to 11% protein). In this sense, they are not complimentary to low quality roughages that contain low protein concentration (3 to 7% protein). In fact, research has shown that starchy feeds can reduce fiber digestion and intake of low quality roughage.

Recent research has shown that the real key in efficiently using grain in low quality forage diets is to include adequate protein along with the grain. Intensive studies looking at the amount of soybean meal necessary to overcome the negative associative effects have been conducted recently. Table 17.4 shows the performance of steers grazing dormant range during winter and supplemented with nothing, corn, soybean meal, or an 80/20 blend of corn and soybean meal (16.5% crude protein, as fed basis). This work demonstrates that straight corn, fed at 1.25% of body weight, resulted in very disappointing weight gains, relative to the amount of feed provided. This is an excellent example of the negative associative effect that grains can have on forage intake and digestion when the degradable protein supply is deficient. However, weight gain was increased by nearly 1 lb per day when 2.5 lbs of soybean meal was fed alone. When soybean meal was blended with the corn, the cattle were much more efficient in utilizing the energy in the grain.

The amount of protein to include in a grain mix will depend on the amount of supplemental feed and the protein concentration in the forage source. Logically, the feeding rate and feed protein level will also need to be adjusted to match the animal's protein and energy requirements. When cattle consume native winter range (3 to 6% protein) and maintenance is the goal, lower feeding rates (0.3 to 0.7% of body weight) and higher protein inclusion rates are necessary. For example, in an experiment with gestating beef cows grazing dormant range, the equivalent of 4.5 lbs per day of a milo-based grain mix was fed. Cows received supplements with 12, 21, 31, or 41% protein, using soybean meal as the protein source. In this study, the optimum supplement response was reached when the grain mix contained 31% protein. This is approximately equivalent to 50% milo and 50% soybean meal. A general rule of thumb based on the amount of feed provided is included in Table 17.5.

An alternative method to determine the appropriate amount of protein to include in a feed is to calculate the degradable protein requirement. Average protein degradability for each feed is shown in Table 12.1 (page 115). In general, degradable protein supply should be a minimum of 11% of total digestible nutrients (TDN) intake when less than 0.5% of body weight concentrate is being fed (true supplementation) to cattle consuming low-quality roughages and forages.

When greater than 0.5% of body weight concentrate will be fed, or when higher-quality forages are provided, degradable protein should be fed to approximate 13% of TDN intake. For example, if a 60% TDN diet were being fed at the rate of 15 lbs per day, the animal would consume 9 lbs of TDN. Degradable protein supply should be 0.13 x 9 = 1.17 lbs per day, which is equivalent to 7.8% of the diet on an as-fed basis (1.17/15 x 100). However, if target gains of 1.5 lbs or more are desired, the concentrate will need to be fed at higher levels compared to true supplementation programs. In this situation, the grass or hay actually becomes a minor portion of the diet, and the feed provides most of the nutrients.

When supplement amount exceeds 0.5% of body weight, several factors need to be considered. First, care must be taken to ensure that all cattle have an equal opportunity to eat the desired amount of supplement. Some cattle may choose a diet of mostly supplement while other cattle consume roughage only. This leads to greater variation in performance, and if livestock consuming only roughage ingest a concentrate, digestive disorders can occur. Additionally, if cattle are not nearby when feed is delivered, some may over-consume supplement, while others receive none. Such shifts in feed intake, regardless of why the shift occurs, are a serious concern if the supplement contains a high level of starch, with acidosis as a possible result. Highly digestible fiber feeds provide more safety when large amounts of supplement are fed.

Table 17.6 includes several rations for calves receiving free-choice high quality grass hay, with a target gain between 1 to 1.7 lbs per day. Separate rations are suggested for hay containing greater than 10% protein and prairie hay or other warm season grass

**Table 17.4 – The effect of protein and energy supplementation on performance of steers grazing dormant native pasture[a].**

| | No supplement | Corn | SBM | Corn + SBM |
|---|---|---|---|---|
| Amount fed, lbs/day | - | 8.2 | 2.5 | 8.2 |
| ADG, lbs/day | 0.12 | 0.64 | 1.06 | 1.7 |

a Initial weight of steers = 631 lbs. Corn + soybean meal mix contained 16.5% protein, as fed basis.
Source: Bodine.

**Table 17.5 – Inclusion rate of oilseed meal in a grain mix based on feeding rate.**

| Amount fed, % of body weight | 0.5 | 0.75 | 1.0 | 1.25 |
|---|---|---|---|---|
| Protein in the mix, % as fed | 25-30 | 22-25 | 18-22 | 15-18 |
| Approximate ratio of grain to SBM[a] | 50/50 | 64/36 | 70/30 | 80/20 |

a If cottonseed meal is substituted for soybean meal, increase inclusion rate by 5 to 6 percentage units.

**Table 17.6 – Rations for growing calves receiving free-choice high quality grass hay (% as fed)[a].**

| | Ration Number | | | | | |
|---|---|---|---|---|---|---|
| Ingredient | 1 | 2 | 3 | 4 | 5 | 6 |
| **High Quality Fescue, Bermudagrass, Wheat, or Sudan Hay (minimum of 10% protein)** | | | | | | |
| Commercial feed product, 12 to 14% protein | 100 | | | | | |
| Wheat middlings | | 68.0 | | | | |
| Corn or milo | | 15.0 | 81.0 | | 39.0 | 19.5 |
| Soybean hulls | | 15.0 | | 87.0 | | 65.0 |
| Wheat | | | | | 48.0 | |
| Soybean or cottonseed meal | | | 16.0 | 10.0 | 10.0 | 13.0 |
| Limestone | | 2.0 | 2.0 | 1.0 | 2.0 | 1.0 |
| Dicalcium phosphate | | | 1.0 | 2.0 | 1.0 | 1.5 |
| Salt/mineral mix | Salt only | Free-choice | Free-choice | Free-choice | Free-choice | Free-choice |
| **High Quality Prairie Hay** | | | | | | |
| Commercial feed product, 16 to 20% protein | 100 | | | | | |
| Wheat middlings | | 83.0 | | | | |
| Corn or milo | | | 69.0 | | 24.0 | 23.0 |
| Soybean hulls | | | | 72.0 | | 45.0 |
| Wheat | | | | | 48.0 | |
| Soybean or cottonseed meal | | 15.0 | 28.0 | 25.0 | 25.0 | 29.0 |
| Limestone[b] | | 2.0 | 2.0 | 1.0 | 2.0 | 1.5 |
| Dicalcium phosphate[b] | | | 1.0 | 2.0 | 1.0 | 1.5 |
| Salt/mineral mix[c] | Salt only | Free-choice | Free-choice | Free-choice | Free-choice | Free-choice |

a Feed ration at the rate of 0.8 to 1.2% of body weight (i.e. 4 to 6 lbs for a 500-lb calf).
b Limestone and dicalcium phosphate are sources of calcium and phosphorus. If these ingredients are not available, increase the soybean or cottonseed meal by 2% or 3%, according to the ration used.
c Vitamin A can be added to the ration to include a minimum of 5,000 international units per pound of feed, or it can be supplied through a fresh commercial salt/mineral product. A feed additive, such as Bovatec®, Rumensin®, Gainpro®, or chlortetracycline should be provided through the feed or salt/mineral mix.

hays that typically contain between 6 and 10% protein. The producer has the option of providing calcium and phosphorus sources such as limestone and dicalcium phosphate; micro minerals such as copper, zinc, and selenium; vitamins A and E; and feed additives in the feed or in a free-choice mineral mix. The formulas shown in Table 17.6 assume that the calcium and phosphorus sources will be provided in the feed mix and the other supplemental nutrients and feed additive will be provided through the mineral mix.

## Feeding Grain with Alfalfa Hay

Alfalfa hay and corn grain are very complementary from a nutritional perspective. Good quality alfalfa hay contains high levels of degradable protein, calcium, potassium, and magnesium, and it is a good source of many of the trace minerals. Corn grain, on the other hand, is a good source of energy and phosphorus. If these feeds are available at reasonable prices, a growing program for calves can be centered on these commodities. A blend of 60% coarsely chopped or long-stemmed alfalfa hay and 40% corn grain (cracked or whole shelled) can sustain weight gains ranging from 1.75 to 2.25 lbs per day. Animal performance will vary greatly depending on hay quality as well as previous management of the cattle and their genetic potential for growth. Alternatively, if the two ingredients cannot be blended, hay can be fed free choice or in limited amounts, and corn can be fed at 1% of body weight. Table 17.7 shows the amount of corn and good quality alfalfa hay required to maintain around 2 lbs per day gain for moderate-frame steer calves ranging from 350 to 650 lbs.

Growing rations based on corn and alfalfa have been used for many years with good success. This alternative is relatively simple, because it can be accomplished with little or no additional feed processing or mixing. Once cattle have been adjusted to this type of ration, the risk of digestive upset is relatively low because a significant amount of roughage is still being fed.

**Caution:** Barley is a rare commodity in Oklahoma, but it is grown or shipped into the state on occasion to be used as a feed grain for livestock. Nutritionists discovered years ago that the combination of barley grain and alfalfa hay is one of the best ways to create severe bloat problems in cattle. A conservative recommendation on utilizing barley for cattle is not to do it in combination with alfalfa hay.

**Table 17.7 – Corn and alfalfa hay rations for steers gaining 2 lbs per day at different body weights.**

| Weight of cattle | 350 | 450 | 550 | 650 |
|---|---|---|---|---|
| Alfalfa hay, lbs as fed[a] | 7.5 | 8.5 | 9.5 | 10.5 |
| Whole or cracked corn, lbs as fed | 3.5 | 4.5 | 5.5 | 6.5 |

a Nutrient content of hay, dry matter basis; 58% TDN, 22% crude protein, 1.37% calcium, 0.22% phosphorus.

Wheat middlings, soybean hulls, and corn gluten feed are considered concentrate products because they are rapidly digested and contain very little effective fiber.

If the roughage source is not pelleted, the factor that limits the amount included in the ration is usually the ability of the feed to flow through the feeder. On the other hand, if the roughage source is pelleted, the limiting factor is usually cost per unit of energy and/or protein. Because these rations are highly digestible and because feed intake can be quite variable, there is always risk of digestive upset, bloat, and founder with self-fed rations. Nevertheless, weight gains of 2 to 3 lbs per day are common with feed conversions ranging from 6 to 8 lbs of feed per pound of weight gain. Obviously, feed costs, feeding facilities, fleshiness of the calves at target shipping date, and available labor must all be carefully considered when evaluating whether to employ a self-fed ration over another alternative. Table 17.8 includes three examples of self-fed rations for growing cattle.

**Table 17.8 – Self-fed rations for growing cattle (% as fed).**

| | Ration number | | |
|---|---|---|---|
| Ingredient | 1 | 2 | 3 |
| Cottonseed hulls[a] | 14.0 | 20.0 | 15.0 |
| Alfalfa pellets | 19.0 | - | - |
| Rolled corn | 51.0 | 30.5 | 22.0 |
| Corn distillers grains | - | 43.0 | - |
| Wheat middlings | - | - | 25.0 |
| Soybean hulls | - | - | 25.0 |
| Cane molasses | 4.2 | 4.5 | 4.5 |
| Soybean meal (47%) | 10.3 | - | 7.5 |
| Calcium carbonate | 0.6 | 1.2 | 1.0 |
| Dicalcium phosphate | 0.6 | - | - |
| Potassium chloride | - | 0.5 | - |
| Salt | 0.25 | 0.25 | 0.25 |
| Magnesium oxide | 0.1 | 0.1 | - |
| Zinc oxide | 0.008 | 0.008 | 0.006 |
| Vitamin A (IU/lb) | 2500 | 2500 | 2500 |
| Feed additive | Variable depending on product | | |

a Coarsely ground or unground peanut hulls can be substituted for cottonseed hulls. Finely ground peanut hulls should not be used.

## Silage Growing Programs

Silage production is an expensive process requiring considerable labor and equipment overhead costs. As a result, fewer cattle enterprises rely on silage as a major forage source compared to 20 years ago. Many operations that use silage in growing rations use custom harvesting services rather than own all of the necessary equipment. The majority of silage harvested for growing programs in Oklahoma is corn, sorghum, or small grain silage. Corn silage contains the highest energy content (Table 12.1 on page 115), but is less frequently used because of production expense and water requirements to grow the corn.

One advantage of a silage-based ration over dry mixed rations is a tremendous reduction in dust. Several ration combinations are show in Table 17.9 using four common silages in combination with wheat or corn grain and cottonseed meal as the protein source. Rations are designed to provide about 2 lbs per day gain for 400-lb calves.

These rations are formulated using the dry matter percentages from Table 12.1. It is critical that the dry matter content of particular silage be known before formulating a ration from the percentages shown in Table 17.9. Other nutrient values from Table 12.1 were used in these formulations. Naturally, more accurate feeding programs can be designed with nutrient analysis information from any batch of silage.

## Limit Fed High-concentrate Rations

A newer and somewhat more aggressive strategy is available for producers who find themselves with calves but no pasture and with too few other roughage sources for a traditional growing/holding program. This strategy involves growing cattle at moderate rates of gain using a limited amount of a higher-concentrate ration. In times of drought or high roughage prices, limit-feeding concentrates may be more economical. However, limit fed high-concentrate diets require skilled management compared to roughage-based diets. Many commercial feed yards have used this approach successfully for a number of years as an alternative growing program for light calves.

When limit fed, producers must calculate the amount of feed to achieve competitive but restricted gains on growing cattle. The computer program PROGFED2 has been developed to calculate the daily amount of feed for a pen of cattle. This program is available through the Oklahoma Cooperative Extension Service free of charge. The daily amount of feed varies with cattle weight, diet dry matter content, energy density in the diet, and the desired rate of gain.

Further critical steps are diet formulation and purchasing, if a commercial product will be used. An experienced nutritionist familiar with limit feeding should be consulted. Rations used for limited intake growing programs require special formulation. The levels of protein, vitamins, and minerals must be increased over the levels used in ad libitum-fed diets.

## Feeding Management

Limit feeding of cattle requires special skills and facilities. Minimum requirements are:

- Adequate bunk space so that most cattle can eat at one time
- Pens small enough that cattle come up to the bunk when fed
- Scales or other methods of weighing out the daily feed
- Skill on the part of the manager
- Roughage feeds to work the cattle up to the limit fed diet
- Sufficient business management skill to evaluate the economic limitations and opportunities in limit feeding of cattle

**Table 17.9 – Silage based growing rations for 400-lb steers gaining two lbs per day[a].**

| Ration No. | 1 | | 2 | | 3 | | 4 | |
|---|---|---|---|---|---|---|---|---|
| | %AF[b] | %DM[c] | %AF | %DM | %AF | %DM | %AF | %DM |
| Wheat silage | 80 | 60.3 | | | | | | |
| Sorghum silage, grain type | | | 84 | 63.5 | | | | |
| Corn silage | | | | | 92 | 81.5 | | |
| Forage sorghum silage | | | | | | | 78.5 | 53.25 |
| Ground or rolled: | | | | | | | | |
| Wheat | | | 11 | 25 | | | | |
| Corn | 15.4 | 30.4 | | | | | 16 | 34.5 |
| Cottonseed meal | 4 | 8 | 4.5 | 10.3 | 7 | 16 | 5 | 11 |
| Limestone | 0.6 | 1.3 | 0.5 | 1.2 | 1 | 2.5 | 0.5 | 1.25 |

a An ionophore or coccidiostat should be added.
b AF = As-fed basis.
c DM = Dry matter basis.

- A sound plan for the use or sale of the cattle following limit growing

Table 17.10 is an example ration for a 450-lb steer to gain about 2.25 lbs per day. This is a high-concentrate ration and requires that cattle be gradually adapted from a forage-based diet. At gains of about 2 lbs per day, the daily amount of feed is sufficient to keep the calves comfortable. For gains below 2 lbs per day, additional roughage may need to be added to increase total feed intake, and keep calves from becoming dissatisfied and restless.

Table 17.11 is a sample output from the computer program illustrating the small amount of feed needed to maintain 2.25 lbs per day gain. The cattle will be fed the same amount of feed each day for a 2-week period. Then, based on the amount of desired gain, feed will be slightly increased during the next 2-week period because a heavier animal is now being fed.

Feed cost per cwt, the ration dry matter percentage, and the net energy values (NEm and NEg) need to be calculated from the ration or obtained from your feed supplier. The initial shrunk weight is either the off-truck weight or the gross weight multiplied by 0.96 for full cattle. Programmed feeding will only work with cattle uniform in weight, size, age, and background. Sorting cattle into similar groups may be necessary before starting.

**Table 17.10 – Feedstuff and nutrient composition of a limit fed ration (as-fed basis).**

| Ingredients | % As-fed | Nutrient | Concentration |
|---|---|---|---|
| Alfalfa pellets | 7.88 | Nem, Mcal/lb. | 0.82 |
| Calcium carb | 0.87 | Neg, Mcal/lb. | 0.52 |
| Bovatec® 68 | 0.02 | Crude prot, % | 14.05 |
| Cane molasses | 4.18 | Fat, % | 3.23 |
| Rolled corn | 65.91 | Crude fiber, % | 7.18 |
| CSM | 13.47 | K, % | 0.81 |
| Salt | 0.28 | CA, % | 0.50 |
| SBM 48 | 2.38 | Phos, % | 0.37 |
| Vitamin A-30 | 0.02 | TDN, % | 71.02 |
| Cottonseed hulls | 4.98 | Dry matter, % | 89.67 |

Judgment must be used when determining expected daily weight gain. Experience has shown that the net energy system, which is used in PROGFED2, is quite accurate. Target gains set between 1.5 to 2.5 lbs per day should be possible. If gains are set too low, dry matter intake will not be sufficient to keep cattle from feeling hungry. Also, cattle in this situation will eat wooden bunks or other semi-edible materials. If the gains are to be set lower than 1.5 lbs per day, the roughage level must be increased over the example ration shown in Table 17.10.

Apparent gains of cattle over short periods of time often are distorted by changes in fill. Limit fed animals often have less fill than ad libitum-fed animals.

Limit feeding can be readily adapted to operations already growing cattle in drylot on complete rations containing traditional roughage levels. Once cattle are on full feed of the traditional ration, the roughage level can be reduced gradually until cattle are consuming the desired amount of high concentrate ration. Silages,

**Table 17.11 – Limit fed schedule for calves.**

| | Inputs |
|---|---|
| Feed cost per cwt as is >> | $7.73 |
| Ration dry matter % >> | 90.00 |
| NEm of feed, mcal/cwt >> | 91.49 |
| NEg of feed, mcal/cwt >> | 58.00 |
| Initial shrunk weight, lbs >> | 375.00 |
| Expected daily weight gain, lbs >> | 2.25 |
| Steers (1) or heifers (2) >> | 1 |
| Number of head per pen >> | 100 |

| Week | Average Weight | Per Animal Per Day lbs DM[a] | Per Animal Per Day lbs AF[b] | Feed/Only Cost of Gain |
|---|---|---|---|---|
| 1-2 | 390.8 | 9.19 | 10.21 | $0.35 |
| 3-4 | 422.3 | 9.74 | 10.82 | $0.37 |
| 5-6 | 453.8 | 10.28 | 11.42 | $0.39 |
| 7-8 | 485.3 | 10.81 | 12.01 | $0.41 |
| 9-10 | 516.8 | 11.33 | 12.59 | $0.43 |
| 11-12 | 548.3 | 11.85 | 13.17 | $0.45 |

a DM = Dry matter basis.
b AF = As-fed basis.

chopped hay, or other roughage sources can be used. Feedlot research shows that calves grown on limit fed rations perform at least as well during subsequent finishing than calves grown on forage or on traditional growing programs in confinement.

## Conclusion

There are a variety of options available for producers to develop supplementation programs for their cattle. In addition to supplementation programs, some producers may decide to use a forage replacement program. In either case, careful consideration of all the elements of the programs must be given. Producers should use the resources mentioned in this chapter to determine which programs will work best for their operations.

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