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Beef Cattle Nutrition Series

Part 2: Establishing Nutritional Requirements

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Introduction

The nutritional requirements for cattle are influenced by two main factors: the animal and the environment in which it is managed. The focus of this publication will be on establishing the nutritional requirements for beef cattle based on body size (weight), stage of production, growth rate and lactation.

One of the first steps in developing a supplemental feeding program for a group of cattle is establishing the group's nutritional requirements. However, shortfalls in supplemental feeding exist when the cattle being fed are different from the type of cattle for which a diet or supplement was formulated.

Establishing nutritional requirements for a group of cattle goes beyond merely looking in a table and coming up with some estimate of requirements. It starts with developing a baseline of information about the herd that can be used to better define the cattle being fed.

Mature Cows

Mature cows are those that have completely developed their skeletal size. These cows will be at least 4 years old. The nutritional requirements for mature cows are based on four basic criteria:

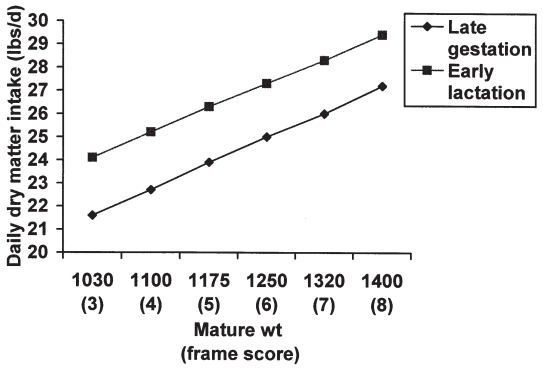
- Body size
- Body condition
- Stage of production
- Level of milk production during lactation

Of the four, level of milk production is most difficult to establish.

Body Size

Establishing the correct body size is important because supplements are generally formulated and fed as a percentage of the dietary intake, and intake is affected by size. **Figure 1** illustrates that as cow size increases, intake also increases. A small-framed cow (1,030 pounds) in late gestation would be expected to consume 22 pounds of dry matter per day, whereas a larger framed (1,250 pounds) cow would be expected to consume almost 25 pounds of dry matter per day. This 3-pound discrepancy in expected intake is one area where supplemental feeding shortfalls can occur.

Figure 1. Daily dry matter intake of beef cows as affected by body size and stage of production (NRC, 6th edition).



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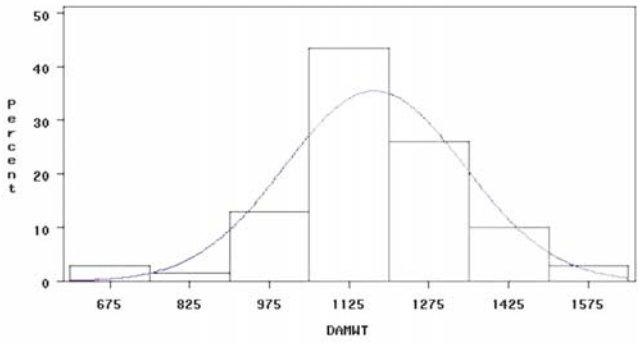
Producers often request assistance from their county Extension agent for formulating supplemental feeds. The most common cow size described by cattle producers is 1,000 pounds. Most small-framed cow herds were phased out in the '80s when continental sires and purebred breeders of English- and Brahman-influenced breeds began to select for larger frame sizes. There are probably few herds that would fit the 1,000-pound cow average.

Data from 69 farms enrolled in the University of Arkansas Cow Herd Performance Testing program indicate the average cow weight at calf weaning (mid-gestation/late lactation) was 1,172 pounds. **Figure 2** shows the distribution of average cow weights on those farms. Overall, less than 15% of the herds had an average cow size of 1,000 pounds, but nearly 40% averaged over 1,200 pounds.

Figure 2. Distribution of cow weights for 69 farms enrolled in the University of Arkansas Cow Herd Performance Testing program.



A number of methods can be used to estimate the average cow size in the herd. The first option would be to weigh the cows. The best time to weigh cows would be at weaning when the cow weight is not heavily influenced by the developing fetus. If scales aren't available, a second option would be to measure the height at the hips of cows when they are in the chute being processed. **Table 1** provides the frame score for cows based on height. Weight can then be estimated based on the following formula.

(Frame score x 75) + 800

A third option for estimating cow weight would be to look through sales receipts for cows recently sold. If using the third option, be sure the cows were not sold for health problems or other conditions that may result in loss of body weight.

Table 1. Hip height of cows of various frame scores at varied ages (BIF, 8th Ed.)

Age (months)	Frame Score					
	3	4	5	6	7	8
24	46.9	48.8	50.7	52.5	54.5	56.4
30	47.5	49.4	51.3	53.1	55.1	57.0
36	48.0	49.8	51.8	53.6	55.5	57.2
48	48.2	50.0	52.0	53.9	55.8	57.5
Mature wt	1,025	1,100	1,175	1,250	1,325	1,400

Mature weight = (frame score x 75) + 800

Body Condition

Cows have energetic priorities. Once a cow becomes pregnant, she will sacrifice body reserves for the developing fetus. After calving, she will sacrifice body reserves to produce milk for her calf if the diet will not support her body maintenance requirement in addition to lactation. Most requirements published for mature beef cows are based on cows in moderate body condition (body condition score of 5). Establishing the body condition of the cows before the supplemental feeding period will help determine if additional supplementation is necessary to improve body condition within a given time or if a lower quality diet could be fed at the expense of removing excess body condition. It is important for optimal reproductive performance to feed cows to achieve a moderate body condition before calving. Producers trying to maintain a short, controlled calving season must pay attention to body condition during late gestation, calving and rebreeding and make adjustments in supplementation when necessary.

Stage of Production

The nutritional requirements for cows differ by stage of production. It is difficult to establish the nutritional requirements of a cow herd that has cows in all stages of production. For example, **Table 2** shows that if mid-gestation cows are supplemented based on a lactating cow's requirement, they will gain excessive body condition. Alternatively, if lactating cows are fed based on the requirements of a mid-gestation cow, they

Table 2. Effect of supplementing poor quality hay (50% TDN, 7.9% CP) fed to a single group of cows in various stages of production on weight and body condition score changes.

		Without Supplement		With Supplement[1]	
	Dry Matter Intake	ADG	Days to Change One BCS[2]	ADG	Days to Change One BCS
Mid-gestation (7 mo. since calving)	22.4	0.27	325	1.41	63
Late gestation (11 mo. since calving)	24.1	-0.70	117	0.59	151
Early lactation (2 mo.)	27.8	-1.37	60	0	infinity

[1] Supplement needed during lactation is 5.5 lb. corn and 0.75 lb. soybean meal.
[2] BCS = Body condition score.

will lose body condition. A controlled breeding season will help confine cows to a closer nutritional status, improve the efficiency of supplemental feeding and help reduce supplemental feed costs. Alternatively, as cows begin to calve, they should be relocated to a separate pasture for feeding.

Level of Milk Production

Figure 3 illustrates the effects of milk production on the TDN requirements for the beef cow. In addition to TDN requirement changes that occur with milk production levels and stage of production, protein requirements change as well. Milk production will vary between breeds and within breeds. **Table 3** provides estimates of peak milk production for some common breeds. If calves relied solely on milk for growth from birth to weaning, establishing a level of milk production within the herd would be much simpler. However, starting at about three months of age, forages and creep feeds (if provided) begin to supply an increasing amount of nutrients for the growing calf. This makes establishing milk production levels within a herd difficult. Some research has focused on using calf weaning weight as a measurement to help estimate milk production levels (**Table 4**). The average 205-day weaning weight of steer calves from 43 herds in Arkansas averaged 512 pounds. Based on the average cow weight of 1,172 pounds and a weaning weight of 512 pounds, a typical level of milk production would be

Figure 3. Change in TDN requirement for an 1,100-pound cow with either low (10 lbs/d) or high (30 lbs/d) peak milk production

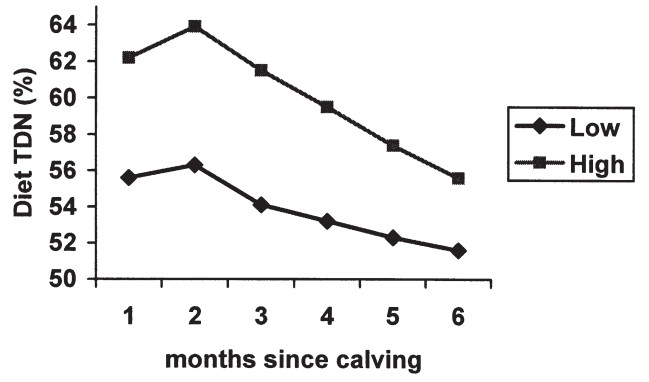


Table 3. Peak milk yield estimates for different breeds (NRC, 1996).

Breed	Peak Milk Production lb per day
Angus	17.6
Brahman	17.6
Brangus	17.6
Charolais	19.8
Gelbvieh	25.3
Hereford	15.4
Limousin	19.8
Simmental	26.4

Table 4. Expected weight of 7-month-old calves based on varied cow weights and levels of milk production (Fox et al., 1988).

	Peak Milk Production (lb/day)				
Weight (frame)	6	12	18	24	30
1025 (3)	431	475	510	546	574
1100 (4)	449	491	526	561	590
1175 (5)	464	506	541	576	607
1250 (6)	497	521	557	590	623
1325 (7)	491	537	572	605	638

approximately 12 to 15 pounds. Taking into account the weight of the calves weaned and the weight of the cows, the data in Table 4 will provide a place to start when establishing nutritional requirements for lactation. Monitoring body condition can help determine if adjustments should be made in establishing an estimated level of milk production for the herd.

Breed Type

Beyond recognizing the differences in milk production potential of various breeds, the nutritional requirements also differ between breed types. Generally, cattle that are Brahman influenced will have a 5% lower TDN requirement than English breeds, and maternal breeds, such as Gelbvieh and Simmental, will have a 10% to 20% higher TDN requirement as compared to English breeds.

Growing Weaned Calves

Growth

Growing calves have the highest TDN and protein requirement, as a percentage of the diet, of any cattle in the beef herd. For this reason, growing calves should be fed separately from the rest of the herd. The nutritional requirements for the weaned calf are determined by the age of the calf and desired growth rate (average daily gain, or ADG). The desired growth rate should be determined based on the expected market or desired breeding date and cost of feed resources. Replacement heifers should be fed to achieve 65% of their mature body weight by breeding and 85% of their mature body weight by calving. Heifers should also calve in a body condition score 6.

To establish a target rate of gain for breeding heifers, knowledge of age, weight and body size at weaning are essential. A gestation calendar (Julian calendar) is also helpful to calculate the number of days between dates. For example, a producer desires to start breeding replacement heifers on March 15. The heifers weigh 475 pounds at weaning on October 1 and have a frame score of 5.5, as determined from age and height at weaning. The projected mature weight using the previously described formula is 1,212 pounds, and the projected target breeding weight is 788 pounds (1,212 x 0.65). The heifers have 165 days (October 1 to March 15) to gain 313 pounds (788 - 475), which calculates to a gain of 1.9 pounds per day (313 ÷ 165).

As weaned calves continue to reach a higher percentage of their mature body size, protein requirements decrease. This should be considered when developing calves over a long period. Adjusting the ration as calves grow and mature will help reduce feed costs since supplemental protein is usually more expensive than supplemental energy.

Metabolic Modifiers

Tabular values for growing cattle are often presented under the conditions of implanting and feeding ionophores such as Bovatec and Rumensin. These management practices elicit improvements in average daily gain and feed efficiency. If these practices are not being implemented with growing cattle, then most tabular rates of gain for a given diet composition will be over-estimated, and a diet that contains a higher percentage of crude protein and TDN may be required.

Considerations for Stress

Weaning, marketing and processing (branding, dehorning, castration) are stressful events in a calf's life and negatively affect the amount of feed a calf will eat. Stress may result in a two- to four-week period before a calf completely resumes normal intake. Therefore, the reduced intake must be taken into account when developing supplements or rations for these cattle.

First-Calf Heifers

First-calf heifers are the second most nutritionally demanding cattle in the herd. In addition to still growing, they have undergone the stress of calving and are now producing milk. Therefore, when establishing the nutrient requirements for first-calf heifers, the information described for mature cows must be considered, plus there remains an additional requirement for growth. Tabular values specific for first-calf heifers can be found in various publications such as *Nutrient Requirement Tables* (MP391).

Mature Bulls

Mature bulls have the lowest nutritional requirement of the herd; however, the maintenance requirement for bulls during a short breeding season (45 to 90 days) increases due to the additional amount of activity. Bulls must be in a good body condition going into the breeding season because oftentimes they will lose body condition during the breeding season. Most bulls will have sufficient time to regain body condition after removal from the herd. However, bulls being used in both spring and fall calving herds will generally require supplementation to regain body condition.

Summary

Many factors contribute to the nutritional requirements of the herd. Minor errors in identifying one of the factors would likely not influence the results of a supplemental feeding program to a large degree. However, under- or over-estimating multiple factors that describe the cow herd and stage of production may lead to inadequate performance or costly supplementation that would lead to excessive body condition gain. In addition, due to the variability in nutritional requirements by type of beef cattle (mature cow, growing heifer, first-calf heifer, etc.), cattle with similar nutrient requirements should be grouped and fed separately.

Complementary Publications

Bull Purchasing and Management (FSA3072)

Grouping the Cow Herd for Winter Feeding (FSA3033)

Selection and Management of Replacement Heifers (FSA3076)

Stocker Cattle Management: Receiving Nutrition (FSA3062)

Beef Cattle Nutrition Series Publications

Part 1. Nutrient Basics (FSA3078)

Part 2. Establishing Nutritional Requirements (FSA3079)

Part 3. Nutrient Requirement Tables (MP391)

Part 4. Formulating Rations (FSA3080)

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