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Feed and Animal Management for Beef Cattle

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Additional NRCS nutrient management technical notes in this series can be found under Technical Notes, Title 190, Nutrient Management, on the NRCS Electronic Directives system at https://directives.sc.egov.usda.gov.

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Feed and Animal Management for Beef Cattle

Introduction

Beef cattle feeding operations typically include weaned calves and backgrounded and stocker cattle that are fed to an optimum beef grade. For short periods of time, beef cows may also be fed in confined feedlots. Distinctly different diets, generally differing in the relative amount of roughage to concentrate levels, are fed during different stages of growth or reproduction. This results in great differences in the volumes of manure produced and the nutrient compositions of those manures from the different life stages. This technical note briefly highlights some factors affecting nutrient excretion with potential dietary adjustments that can be used to minimize excess nutrient excretion.

A critical part of feed management is to accurately formulate diets and manage the feeding of them so the nutrients fed consistently match the nutrients needed at each stage and rate of growth. For example, table 1 illustrates how the amount of nutrients needed each day change with stage of growth and rate of gain for growing cattle. Table 2 illustrates how daily nutrients needed by beef cows change by stage of the reproductive cycle. These tables are only examples to illustrate how the diet formula needs to be specific for each feeding situation; the concentration of nutrients needed in the diet for a pen of animals changes with the mature size, level of production, and dry matter intake.

Diet Formulation

Diets should be formulated and updated regularly to avoid the overfeeding of nutrients or fluctuations in performance. The common standard for diet formulation is the National Research Council (NRC) publication “Nutrient Requirements of Beef Cattle,” which is updated periodically. This publication provides equations to compute nutrient requirements for any mature size and growth rate. Therefore, actual dry matter intakes and a computer program containing NRC and/or other research-based equations to accurately predict nutrient requirements should be used to formulate diets. Due to the complexity of formulating diets to optimize production while minimizing excretion, producers not trained in nutrition should seek help from qualified nutritionists.

Diets fed to cattle may contain excess nutrients as a safety factor to minimize poor growth or performance due to variation of nutrients in feed sources and performance variation in the cattle. Unfortunately, this safety factor is often substantially more than any of the animals in the group need, and the animals become a source of excess nutrients in the environment. By properly balancing protein, phosphorus (P), and other nutrients in the diet to meet animal performance expectations, excretion of unnecessary excess nutrients can be minimized, reducing their potential to contribute to environmental degradation, particularly to water and air quality.

Routine feed analyses, especially when a new source of feed is used, are critical for proper diet formulation and reduction in nutrient excretion. The moisture content of feed ingredients, especially silage and wet byproducts, should be checked frequently to produce formulations that accurately reflect the nutrient content of available feeds.

Table 1: Protein, Calcium, and Phosphorus Requirements for Growing and Finishing Beef Cattle[1]

Body Weight, pounds	**525**	**650**	**775**	**900**	**1025**
Dry Matter Intake, pounds/day	**14**	**17**	**19.5**	**21.5**	**23.5**
Daily Gain, pounds	-----Crude Protein, pounds per day-----				
1.10 (0.5kg)	1.22	1.36	1.49	1.57	1.65
2.2 (1.0kg)	1.55	1.69	1.82	1.86	1.91
3.3 (1.5kg)	1.87	2.01	2.13	2.14	2.15
4.4 (2.0kg)	2.18	2.32	2.43	2.40	2.38
5.5 (2.5kg)	2.49	2.62	2.73	2.66	2.60
Daily Gain, pounds	-----Calcium, pounds per day-----				
1.10	0.04	0.04	0.05	0.05	0.05
2.2	0.06	0.06	0.06	0.06	0.06
3.3	0.08	0.08	0.08	0.07	0.07
4.4	0.10	0.09	0.09	0.09	0.08
5.5	0.11	0.11	0.10	0.10	0.09
Daily Gain, pounds	-----Phosphorus, pounds per day-----				
1.10	0.02	0.02	0.03	0.03	0.03
2.2	0.03	0.03	0.03	0.03	0.04
3.3	0.04	0.04	0.04	0.04	0.04
4.4	0.04	0.04	0.04	0.05	0.05
5.5	0.05	0.05	0.05	0.05	0.05

1/ Weight at small marbling = 1,200 pounds. Adapted from table 9-1 with modifications of National Research Council. 1996. Nutrient Requirements of Beef Cattle: Seventh Revised Edition. Washington, D.C.: The National Academies Press.

Table 2. Protein, Calcium, and Phosphorus Requirements for Beef Cows[1]

Months Since Calving	**Body Weight**	**Dry Matter Intake**	**Crude Protein**	**Calcium**	**Phosphorus**
	pounds	----pounds per day-----			
0 (Calving)	1340	24.6	2.20	0.06	0.04
1	1200	26.8	2.71	0.08	0.05
2 (Peak Milk)	1200	27.8	2.97	0.09	0.06
3	1205	28.4	2.82	0.08	0.06
4	1205	27.4	2.54	0.07	0.05
5	1205	26.5	2.26	0.06	0.04
6	1210	25.7	2.04	0.06	0.04
7 (Weaning)	1215	24.2	1.45	0.04	0.03
8	1225	24.1	1.49	0.04	0.03
9	1240	24.0	1.57	0.04	0.03
10	1260	23.9	1.69	0.06	0.04
11	1290	24.1	1.89	0.08	0.04

1/ Mature weight at body condition 5 = 1,200 lb., peak milk = 20 lb., calf birth weight = 86 lb., calving interval = 12 months. Adapted from table 9-7 with modifications of National Research Council. 1996. Nutrient Requirements of Beef Cattle: Seventh Revised Edition. Washington, D.C.: The National Academies Press.

Feeding cattle using the metabolizable protein system as described by the NRC rather than crude protein is one way to better characterize rumen and lower digestive tract nutritional needs. Selecting and balancing the right type of protein sources are important to meeting the amino acid needs of the animal and for minimizing excretion. Byproducts are often utilized in cattle diets, one should note the digestibility (availability) of nutrients from each feed ingredient source, as well as significant nutrient excesses. The content and availability of amino acids from different protein sources varies considerably, leading to inadvertent overfeeding of some amino acids that then contribute to nitrogen (N) excretion. It has been estimated that selecting optimal levels of the right type of protein to more accurately match animal requirements can reduce N excretion by as much as 25 percent.

Balancing nutrient levels can be challenging when byproducts are used. An important feed source for the beef industry, byproduct feeds include roughages and concentrates other than the primary products of plant and animal production, and byproducts from industrial manufacturing. Examples include grain stover and fermentation byproducts, but other byproduct feeds may include such things as cotton seed meal, bakery waste, and even cookie meal. In some areas, food waste from nonindustrial sources may be fed to animals but should be done so in accordance with Federal and State regulations.

The availability and levels of N and P in byproducts are especially important. In addition, fermentation byproducts used as energy or protein sources may increase P excretion because of the concentration of P in the byproduct as carbohydrate is removed through fermentation. Therefore, more intensive management of manure storage, treatment, and utilization may be required.

In addition, P has routinely been added into mineral mixes for cattle. However, the normal level of P in most typical ingredients in cattle rations exceeds their P requirements. Recent research has shown that P excretion can be reduced by 20–30 percent by not adding supplemental P to the diet. One notable exception is forage-based diets, especially when forage quality is poor. In this case, there may be a need to add supplemental P to the diet to meet some cattle requirements.

The dietary salt intake level should be reduced in cattle feeds in semiarid and arid climates where salinity problems can exist and where sodium accumulation can adversely affect crop production. In addition, beware of potassium accumulation in forages receiving high levels of manure application. This can potentially cause grass tetany problems with cattle consuming such forages.

Phase feeding and grouping strategies may also be used to more nearly meet the nutritional needs of cattle of a common age and size, and sex. Uniform groups (by stage of growth) allow producers to utilize diets that come closer to the actual needs of all the individual animals in the group since there is less variation between animals.

Overfeeding of nutrients within a group can be significantly reduced. Dividing the growth period of the cattle into several periods with a smaller spread in body weight allows producers to provide diets that more closely meet the cattle’s nutrient requirements. This approach may reduce N and P excretion by at least 5–10%.

Enteric methane production in the rumen of cattle is a major source of greenhouse gases (GHGs) that contribute to climate change. Feeding compounds called ionophores, or feeding certain fats, can reduce methane production. Ongoing research provides hope that even larger sustained reductions in GHGs can be obtained using feeding techniques and certain products.

Nutrient Value of Water

Water is often called the forgotten nutrient. The mineral content of the water supply should be considered with regard to the total intake of dietary minerals. Depending on the quality of the available water supply, water intake may make a substantial contribution to daily mineral intake, particularly sulfur, and in some areas of the country, salt. Routine water sampling can help the nutritionist formulate properly for minerals that need to be added to the diet to meet the animal's actual requirements.

Feed Management

Feed Bunk Management

Good bunk management is imperative to reducing feed wastage. This involves checking feed intake levels and adjusting intake to closely meet the requirements of the size of the cattle involved. Consideration should also be given to the amount of feed being wasted in the feedlot operation. In some cases, refused feed is scraped up from the feeding area and is not re-fed. In this situation, waste removed from the lot includes both the wasted feed and the manure nutrients. On a 1,000 animal feedlot, feeding 25 pounds of dry matter per animal per day, with a minimal 5 percent wastage rate, almost 230 tons of waste nutrients will need to be disposed of each year. Feed wastage is also of concern from a cost standpoint; a good plan to minimize feed wastage can also affect the profitability of the enterprise.

Feed Storage

Another aspect of feed management considers nutrient losses during feed storage. Depending upon how feed ingredients are stored, nutrients may be directly lost to the environment as a result of poor feed storage conditions or as a result of rainfall on uncovered feed. Something as simple as covering or wrapping hay bales can reduce spoilage and loss by a substantial amount. Fermented feeds, such as silage, can produce a leachate. Containment of silage leachate, as well as good management of all feed storage areas and feed transport, is advised so that feed-based nutrients will not be lost directly to the environment.

Feeding Growth Promotants

Growth promotants are among the many tools used by producers to raise beef quickly, using less feed, while maintaining high standards of animal health, carcass quality, and food safety. Growth promotants include ionophores, growth implants, and beta-agonists. Ionophores are antimicrobials delivered through cattle feed to improve nutrient availability to the animal. Ionophores improve feed efficiency and weight gain by selectively inhibiting methane producing bacteria, allowing the beneficial rumen bacteria to make more feed energy available to the animal.

Though not part of the feeding regimen, hormonal growth implants are another type of growth promotant that impacts how nutrients are used by the animal after the nutrients have been absorbed into the bloodstream. Growth implants, delivered through a pellet under the skin in the animal's ear, enhance the reproductive hormones that occur naturally in the animal. In steers, implants replace some of the hormones that were removed when the animal was castrated. Implants generally encourage protein deposition and discourage fat deposition. This improves both weight gain and feed conversion.

There are two beta-agonist compounds approved by the U.S. Food and Drug Administration for use in beef production in the United States—ractopamine hydrochloride and zilpaterol hydrochloride. Beta-agonists, like other technologies used in livestock production, increase the efficiency of production of lean meat. Improved efficiency reduces the resources (grains, water, and land) needed to produce meat.

This improves the overall sustainability of livestock production by allowing more meat to be produced with less inputs.

Summary

A variety of feed management practices can impact the nutrient content of excreted beef cattle manure. Consider feed management alternatives during the development of Comprehensive Nutrient Management Plans (CNMPs) and conservation plans. The NRC's "Nutrient Requirements of Beef Cattle" provides equations, tables, and guidelines for evaluating all beef cattle diets, including the breeding herd. Also, consult qualified nutritionists to accurately evaluate current or planned diet compositions. A summary of the potential for the various activities to impact nutrients in beef cattle manure is shown in table 3.

The actual impact of a feed management strategy or strategies on a beef operation can only be determined by analysis of the manure after the strategy has been implemented. During the development of CNMPs, the potential impact of such strategies can be estimated using values in table 3. In using data from this table, planners are encouraged to be conservative in their selection of factors. Also, it is important to remember that the impact of using multiple strategies in a single diet is not likely to be additive for each single strategy being used. Rather it is more likely to be something greater than the value for the strategy with the smallest impact, but less than the sum of the values for all of the individual strategies being used.

Table 3: Potential for Feed Management to Impact Nutrients in Beef Cattle Manure

Strategy	Nitrogen Reduction %	Phosphorus Reduction %
Minimize Dietary Nutrient Excesses	0–25	0–30
Protein Manipulation	0–25	n/a[1]
Growth Promotants	5	5
Phase feeding	5–10	5–10

1/ Not applicable

During the development of CNMPs it is better to underestimate the potential impact of feed management than to overestimate it. Later, the plan can be modified and fine-tuned based upon data accumulated from the actual production operation.

References

National Research Council. 1996. Nutrient Requirements of Beef Cattle: Seventh Revised Edition. Washington, D.C.: The National Academies Press. https://doi.org/10.17226/9791.

Appendix 1

Glossary of Terms

Byproducts.—Feed ingredients sources that are normally waste products from other industries.

Crude Protein.—A measure of the dietary protein that assumes that the average amino acid in protein contains 16 percent N. Thus, total chemically determined N times 6.25 (or 100 divided by 16) = crude protein.

Fermentation Byproducts.—Byproducts that have been processed by anaerobic fermentation.

Fermented Feeds.—Feeds that have been processed and preserved by anaerobic fermentation. A typical example is acid fermentation of whole corn plant silage.

Grass Tetany.—A nutritional disease caused by inadequate magnesium in the blood. It most commonly occurs among lactating animals grazing on rapidly growing, lush spring pastures containing less than 0.2 percent magnesium and more than 3 percent potassium and 4 percent nitrogen (25% protein).

Metabolizable Protein.—Protein (amino acids) absorbed from the small intestine of ruminants. Contains bacterial protein and undegraded intake protein.

Phase Feeding.—Changing the nutrient levels in diets as animal's age to more closely meet their nutrient requirements.

Ruminant.—An animal capable of digesting forages (roughages) because they have a large stomach with four compartments with microorganisms present.