TECHNICAL NOTES

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NUTRIENT MANAGEMENT – NO. 2

FEED AND ANIMAL MANAGEMENT FOR BEEF CATTLE

DESCRIPTION

The attached material was prepared by Dr. Alan Sutton, Professor of Animal Science at Purdue University and Charles H. Lander, NRCS, National Agronomist.

This technical note provides a general discussion on how the feed and animal management for beef cattle can be used to alter the nutrient content in the excreted manure.

USDA United States Department of Agriculture

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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, beef cows may be fed in confined feedlots. Distinctly different diets, generally differing in the amount of roughage relative 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 at the different life stages. This technical note briefly highlights some factors affecting nutrient excretion, along with potential dietary adjustments that can 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 shows how the amount of nutrients needed daily changes 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 particular 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 most common standard for diet formulation is the National Research Council's (NRC) publication, *Nutrient Requirements of Beef Cattle*, 1996. This publication provides equations to compute nutrient requirements for any mature size and growth rate. Therefore, actual dry matter intakes and a computer program that includes NRC's and/or other research-based equations are needed to accurately predict how nutrient requirements should be used to formulate diets. Because of 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 safely factor to minimize poor growth or performance because of variation of nutrients in feed sources and performance variation in the cattle. By properly balancing

This is the second in a series of nutrient management technical notes on feeding management.

Series was prepared by **Dr. Alan Sutton**, professor of Animal Science at Purdue University, West Lafayette, Indiana, and **Charles H. Lander**, national agronomist, NRCS, Washington, DC. This series was developed from material published by the Federation of Animal Science Societies (FASS), Savoy, Illinois.

Table 1 Protein, calcium, and phosphorus requirements for growing and finishing beef cattle [1]

Body weight, lb =	525	650	775	900	1,025
Dry matter intake, lb/d =	14	17	19.5	21.5	23.5
Daily gain, lb	-------- Crude protein, lb/d --------				
1.0	1.22	1.36	1.49	1.57	1.65
1.8	1.55	1.69	1.82	1.86	1.91
2.5	1.87	2.01	2.13	2.14	2.15
3.3	2.18	2.32	2.43	2.40	2.38
4.0	2.49	2.62	2.73	2.66	2.60
	----------- Calcium, lb/d ----------				
1.0	0.04	0.04	0.05	0.05	0.05
1.8	0.06	0.06	0.06	0.06	0.06
2.5	0.08	0.08	0.08	0.07	0.07
3.3	0.10	0.09	0.09	0.09	0.08
4.0	0.11	0.11	0.10	0.10	0.09
	--------- Phosphorus, lb/d ---------				
1.0	0.02	0.02	0.03	0.03	0.03
1.8	0.03	0.03	0.03	0.03	0.04
2.5	0.04	0.04	0.04	0.04	0.04
3.3	0.04	0.04	0.04	0.05	0.05
4.0	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, Nutrient Requirements of Beef Cattle, 7th Edt., 1996, National Research Council, National Academy Press, 2101 Constitution Ave., Washington, DC 20418 (J.G. Buchanan-Smith, Chair, Subcommittee on Beef Cattle Nutrition).

Table 2 Protein, calcium, and phosphorus requirements for beef cows [1]

Months since calving	Body weight (lb)	Dry matter intake (lb/d)	Crude protein (lb/d)	Calcium (lb/d)	Phosphorus (lb/d)
0 (calving)	1,340	24.6	2.20	0.06	0.04
1	1,200	26.8	2.71	0.08	0.05
2 (peak milk)	1,200	27.8	2.97	0.09	0.06
3	1,205	28.4	2.82	0.08	0.06
4	1,205	27.4	2.54	0.07	0.05
5	1,205	26.5	2.26	0.06	0.04
6	1,210	25.7	2.04	0.06	0.04
7 (weaning)	1,215	24.2	1.45	0.04	0.03
8	1,225	24.1	1.49	0.04	0.03
9	1,240	24.0	1.57	0.04	0.03
10	1,260	23.9	1.69	0.06	0.04
11	1,290	24.1	1.89	0.08	0.04

1 Mature weight at body condition 5=1,200 pounds, peak milk=20 pounds, calf birth weight=86 pounds, calving interval=12 months. Adapted from table 9–7 with modifications, Nutrient Requirements for Beef Cattle, 7th Edt., 1996, National Research Council, National Academy of Sciences, National Academy Press, 2101 Constitution Ave., Washington, DC 20418 (J.G. Buchanan-Smith, Chair, Subcommittee on Beef Cattle Nutrition).

protein, phosphorus (P), and the 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 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 by-products, should be checked frequently to produce formulations that accurately reflect the nutrient content of available feeds.

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. Because by-products 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. Some estimates are 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 by-products are used. An important feed source for the beef industry, by-product feeds include roughages and concentrates other than the primary products of plant and animal production, and by-products from industrial manufacturing. Examples include grain stover and fermentation by-products. The availability and levels of N and P are especially important. In addition, fermentation by-products used as energy or protein sources may increase P excretion. Therefore, more intensive management of manure storage, treatment, and utilization may be required.

In addition, P is routinely 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 to 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 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 meet more nearly the nutritional needs of cattle of a common age, size, and sex. Uniform groups (by stage of growth) allow the producer to use diets that come closer to the actual needs of all the individual animals in the group since there is less variation among 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 to 10 percent.

Nutrient value of water. The mineral content of the water supply should be considered with regard to the total intake of dietary minerals. Depending on the quality of water supply available, water intake may substantially contribute to daily mineral intake, particularly with regard to sulfur, and in some areas of the country, salt. Routine water sampling can help the nutritionist formulate properly the amount of minerals to add to the diet to meet the animal's actual requirements.

Feed management

Feed bunk management. Good bunk management is imperative to reduce 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 how much feed is being wasted in the feedlot operation. In some cases refused feed is scraped from the feeding area and is not re-fed. In this situation waste removed from the lot includes the wasted feed and the manure nutrients.

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 of rainfall on uncovered feed.

Fermented feeds, such as silage, can produce a leachate. Containment of silage leachate and good management of all feed storage areas and feed transport are advised so that feed-based nutrients are not lost directly to the environment.

Summary

The National Research Council's *Nutrient Requirements for Beef Cattle* (1996) 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. Consider feed management alternatives during the development of Conservation Plans, especially during the development of Comprehensive Nutrient Management Plans (CNMPs).

Varies feed management practices can impact the nutrient content of excreted beef cattle manure. Table 3 summarizes the potential for various activities to impact nutrients in beef cattle manure.

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

Table 3 Potential for feed management to impact nutrients in beef cattle manure [1]

Strategy	Nitrogen reduction (%)	Phosphorus reduction (%)
Minimize dietary nutrient excesses	0–25	0–30
Protein manipulation	0–25	n/a [2]
Growth promotants	5	5
Phase feeding	5–10	5–10

1 Table adapted from Federation of Animal Science Societies (FASS) publication, *Dietary Adjustments to Minimize Nutrient Excretion from Livestock and Poultry*, January 2001.
2 Not applicable.

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 the individual strategies being used. 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 based upon data accumulated from the actual production operation.

Glossary

By-products. Feed ingredients from sources that are normally waste products from other industries.

Crude protein. A measure of dietary protein that is based on the assumption that the average amino acid in a protein contains 16 percent nitrogen. Thus, total chemically determined nitrogen × 6.25 (100 ÷ 16) = crude protein.

Fermentation by-products. By-products 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. It contains bacterial protein and undegraded intake protein.

Phase feeding. Changing the nutrient concentrations in a series of diets formulated to meet an animal's nutrient requirements more precisely at a particular stage of growth or production.

Ruminant. An animal capable of digesting forages (roughages) because it has a large stomach with four compartments that have micro-organisms present.

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