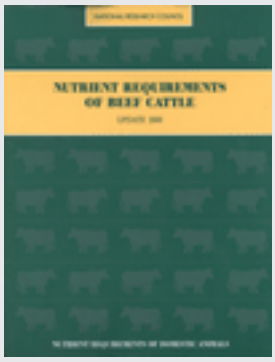

Nutrient Requirements of Beef Cattle: Seventh Revised Edition: Update 2000

DETAILS

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Overview

This seventh revised edition of *Nutrient Requirements of Beef Cattle* is a significant revision of the sixth edition. One major improvement involves expansion in describing different cattle. Requirements are also defined in terms of a greater variety of management and environmental conditions than was possible in previous editions. One result of this innovation is that there is now a greater responsibility for the user to define the animals and their conditions before proceeding to determine nutrient requirements.

A second major improvement involves presentation of requirements using computer models. Computer models are the only effective way to take animal variation into account. Also important is the fact that computer models can describe the dynamic state of the animal, which is not possible with the presentation of discrete tabular values of nutrient requirements alone. The dynamic state of describing nutrient requirements of ruminants refers here to the fact that feed ingredients can affect absorbable nutrients, hence potential performance, which has a feedback on requirements. This situation is best illustrated with protein. Diet can have a major effect on protein, which is degraded in the rumen or undegraded and bypassed to the lower portion of the gastrointestinal tract. Energy in the diet affects the amount of microbial protein that can be synthesized in the rumen. Hence, the amount of total true protein that the animal absorbs from the gut, equivalent to metabolizable protein, depends on the energy and degradable protein level of the diet. Net energy and metabolizable protein set the potential growth, reproductive, or lactational performance, which then dictates the need for other nutrients, such as calcium and phosphorus. For these reasons, the subcommittee chose to present nutrient requirements in terms of evaluating rations or diets, rather than as discrete recommendations for nutrients to fulfill a given level of performance. Net energy is used to evaluate ration and diet energy, which is the same format used in the sixth edition. To evaluate protein requirements in this edition, it is necessary to know both the crude protein concentration in the feedstuffs being used as well as the rumen degradability of that protein.

Modeling the dynamic state of nutrient requirements in cattle is a major departure for those familiar with seeing nutrient requirements in tabular form only. To satisfy those who might wish to use the information in a format similar to the previous edition, a table generator is provided. However, because of the dynamic state of protein digestion, protein requirements in the table generator are expressed as metabolizable rather than crude protein.

The model prepared in this publication is at two levels. For the first level, equations are very similar to equations used in the sixth edition. Revision of requirements at this level have, for the most part, only updated equations when there was sufficient new information to justify this. The subcommittee chose to add a second modeling level, which is more mechanistic than level 1 and was included to describe the dynamic state of digestion in and passage of digesta through the reticulo-rumen. Level 1 is recommended for users who were comfortable with using nutrient requirements recommended in the previous edition of this publication and who want the greatest accuracy in evaluating requirements. Level 2 is offered as a model to give a greater interpretation of the results, for example to diagnose underperformance of animals on a given diet. The subcommittee anticipates that as users become comfortable with level 2 in accuracy of prediction, level 2 will become the modeling level used to evaluate rations as well.

Chapter 1 contains a discussion of energy as a nutrient by providing basic definitions and terms used to describe energy content of feedstuffs. There is also an extensive discussion of maintenance energy and factors such as cattle breed, sex, physiological state, and environment that can alter maintenance requirements. This chapter concludes with a discussion of use of energy from body weight loss.

Chapter 2 is a review of protein digestion and metabolism and presents the basis for considering metabolizable protein (MP), or amino acids absorbed from the gastrointestinal tract, and the utilization of MP in setting protein requirements for beef cattle. There is a discussion of factors affecting microbial protein synthesis, which includes consideration of needs for energy and degradable protein. A value for the maintenance requirement for protein, based on metabolic and endogenous losses of nitrogen, is proposed as well as an equation to estimate conversion of MP to net protein. Chapter 2 concludes with a section on validation of recommendations for protein requirements of both growing-finishing and breeding cattle.

A discussion of cattle size and body composition with reference to energy and protein begins Chapter 3. This discussion provides the basis for using mature size as a reference point to unify description of nutrient requirements across animals of different mature size and as affected by liveweight, age, and physiological state. To use a system of nutrient requirements based on a constant body fat composition, it is necessary to understand factors that affect rate of growth such as use of anabolic implants or ionophores, and a discussion of these is included. Chapter 3 also includes a discussion of compensatory growth and validation of the energy and protein requirement system. In addition, Chapter 3 considers predicting target weight gains for replacement heifers and discusses variables that affect nutrient requirements of breeding females. Chapter 3 concludes by describing a mechanism to predict energy reserves of beef cows through the use of body condition score, body weight, and body composition. It provides a relationship between condition score and percent fat in the body.

Unique considerations in setting nutrient requirements for breeding animals are considered in Chapter 4. It includes a discussion of factors affecting calf birth weight, energy, and protein requirements for gestation, and nutrient metabolism by the gravid uterus and placenta. In the discussion of lactation requirements, Chapter 4 reviews the literature on determining milk yield in beef cows and energy requirements for milk production. This chapter also describes factors affecting heifer development and breeding performance of mature cows and bulls.

Macromineral and micromineral requirements are presented in Chapter 5. Where possible, discussion of each mineral includes the role of the mineral in physiological processes of cattle, the bases for setting requirements of these nutrients, and relevant aspects about digestion, absorption, and metabolism. Signs of deficiency, factors affecting requirements, and toxicity and maximum tolerable concentrations in diets are discussed also. A table summarizing recommended dietary concentrations and maximal tolerable concentrations of some minerals is included in this chapter and differentiates recommendations according to physiological function. Sufficient information exists to specify higher levels of magnesium, potassium, sodium (salt), and manganese in diets for breeding cattle, particularly lactating animals, compared to growing and finishing cattle. Calcium and phosphorus requirements, as in the previous edition, are presented in equation format (in Chapter 7) to calculate recommended daily intakes for a comprehensive description of cattle types and management circumstances. Calcium requirements are similar to those established in the previous edition of this publication, but phosphorus requirements have been modified slightly from the previous edition and are discussed in the context of some recent studies on these minerals.

Maximum tolerable concentrations of other minerals have been listed in Chapter 5. In the case of chromium, molybdenum, and nickel, evidence that these minerals are essential to cattle has been presented, but there are insufficient data on which to base dietary requirements.

Requirements for vitamins and water have been considered in Chapter 6. Besides the fat-soluble vitamins, for which the evidence to support a required concentration in the diet is very strong, the literature on the water-soluble B vitamins is reviewed to document where supplementation of diets for beef cattle may be beneficial. A discussion of water requirements of beef cattle includes a table detailing these requirements as affected by ambient temperature and physiological function and liveweight.

Factors affecting feed intake of beef cattle are reviewed in Chapter 7. This chapter includes a review of how physiological factors affect feed intake. There is a section on prediction of feed intake by beef cattle and this includes validation of equations used for the models of requirements. There is a special section in this chapter to consider intake of all-forage diets.

Chapter 8 provides an overview of the effects of stress on nutrient requirements. Effects on energy, protein, mineral, and vitamin requirements are addressed.

Chapter 9 presents the application of new information to formulate equations and models for nutrient requirements. Tables of requirements generated by the model are provided for growing-finishing steers or heifers, for pregnant replacement heifers, for lactating cows, and for bulls. A step-by-step example of how to predict average daily gain and crude protein requirements is also presented.

Chapter 10 provides all of the equations used in the model plus a thorough description of the data contained in the feed library on the model disk.

Chapter 11 provides tables of nutrient composition of feedstuffs commonly used in beef cattle diets, including estimates of variation of nutrient content and discussion of processing effects.