

Progress on 8th Edition of the Nutrient Requirements of Dairy Cattle

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Abstract

Production of the *Nutrient Requirements of Dairy Cattle, 8th Revised Edition* is underway. It began in the spring of 2013 when the Foundation of the American Dairy Science Association (**ADSA**) brought forth a funding proposal to the Board of Directors of ADSA. Foundation members had received many comments from ADSA professional members that the current 7th Edition was outdated and that considerable new knowledge was available for inclusion in a new revised edition. The National Research Council (**NRC**) required \$400,000 in-hand to initiate the process of producing an updated Nutrient Requirements document for most species, with at least 51% coming from financially disinterested (not for profit) parties. The Foundation designated \$204,000 as seed money to initiate the fund-raising process. The proposal was approved by the ADSA Board of Directors, donors were sought, and by the end of July 2013, 11 organizations (two not for profit and 9 for profit entities) each pledged \$19,600 (\$215,600) to supplement the ADSA Foundation dollars. ADSA also sought input on subject matter that should be considered in the new edition. Ideas from over 70 people were provided unedited to NRC. The official start on work on the 8th Revised Edition began with the approval of the plan of work by the Executive Board of NRC in September, 2013. ADSA and its Foundation have established a new model for

funding and updating future revisions of specie-specific nutrient requirement publications.

Introduction

The Morrill Land Grant Act was signed into law by President Lincoln on July 2, 1862. Eight months later on March 3, 1863, President Lincoln signed an Act of Incorporation from Congress that created the National Academy of Science (**NAS**). These two historically significant pieces of legislation signed by President Lincoln literally created key elements of the future scientific roadmap for the United States. In 1917, the NRC was created as the operational arm of the NAS to address issues of national science policy and concern. Subsequently, the National Academy of Engineering (1964) and the Institute of Medicine (1970) became additional elements of the National Academies.

Dairy educators, nutritionists, and consultants world-wide depend on the Nutrient Requirements of Dairy Cattle published by the National Research Council for advice and guidance in feeding dairy cattle. The document is recognized as the basis for Federal and state regulation of dairy feeds.

Background

The NRC receives no legislatively-mandated funding from the Federal government

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for its publications. It depends on money generated through sale of its reports by the National Academy Press, plus grants from public and private sponsors. For example, *Nutrient Requirements of Dairy Cattle, 7th revised edition* published in 2001 recognized the support of the Agricultural Research Service within USDA, the Center for Veterinary Medicine of the US Department of Health and Human Services, and the American Feed Industry Association for their financial contributions.

A minimum of \$400,000, 51% of which must come from non-interested parties, is required by NRC to initiate a new document, such as one on nutrient requirements. The Foundation, led by Dr. Cindie Luhman, submitted a proposal to the Board of Directors in the spring of 2013 that as a non-interested party, it would provide \$204,000 (51%) toward the funding of writing *Nutrient Requirements of Dairy Cattle, 8th Revised Edition*. The Board rapidly approved the recommendation of the Foundation and began a fund raising campaign in June, seeking 10 entities that would each contribute \$19,600. In early August, ADSA announced that 11 organizations (Table 1) committed \$19,600 each for a total \$419,600.

Prior to the 2013 Joint Annual Meeting in Indianapolis, an announcement was sent by e-mail inviting all members to a meeting to discuss potential content in the new NRC document. Over 110 people participated in the discussion. ADSA also established a designated area on the ADSA.org website where people could submit suggestions for updates, expansion/refinements, and additions for consideration. At the end of September, 2013, over 70 individuals and/or groups from around the world submitted comments to the website. All comments were provided unedited to the office of Ms. Robin Schoen at the NRC.

In January, 2014, the NRC called for nominees for committee members with qualifications and experience to serve on the Subcommittee of Dairy Nutrition. The subcommittee will be charged with writing the *Nutrient Requirements of Dairy Cattle, 8th Revised Edition*. The official document for the work plan follows.

The National Research Council Board on Agriculture and Natural Resources Nutrient Requirements of Dairy Cattle, 8th edition

Summary

A committee appointed by the Chairman of the National Research Council will prepare a report that reviews the scientific literature on the nutrition of dairy cattle and updates the nutrient requirements contained in the 2001 NRC publication *Nutrient Requirements of Dairy Cattle*.

A computer model of dairy cattle nutrition may be developed in conjunction with the updated report.

Study Description

The U.S. dairy industry has an annual economic impact of more than \$100 billion and is responsible for hundreds of thousands of jobs nationwide. There are approximately 55,000 dairy farms and 500 milk-processing plants in the U.S., with dairy farms in all 50 states. About 9.3 million cows in the U.S. produce more than 190 billion pounds of fluid milk annually, a greater supply than any other country in the world. From it, the U. S. produces a variety of high-quality dairy products for consumption at home, as well as for export around the world. Milk and dairy products supply 70% of the calcium needs of the U.S. population.

For more than 60 years, the National Research Council-National Academy of Sciences (NRC-NAS) has been releasing reports on the nutrient requirements of various animal species, such as poultry, swine, beef cattle, dairy cattle, horses, small ruminants, dogs and cats, and fish. For dairy cattle in particular, seven revised editions have been released, with the original publication of the *Recommended Nutritional Allowances for Dairy Cattle* in 1945. These publications have been used throughout the United States and the world to set national and international feeding standards for dairy cattle.

The 7th revised edition of *The Nutrient Requirements of Dairy Cattle* was published over 10 years ago (2001), and since its release, a significant amount of information has been accumulated by researchers and some material in the most recent edition has become outdated. The availability of new information on the various aspects of dairy cattle nutrition that were addressed in the 2001 report and information on aspects that were not covered then, such as the environmental impacts of dairy cattle emissions and the effects of co-products from the bio-fuels industry and new feed additives, warrants the development of a new report.

Some key areas in which there are new data and updates are needed include:

Nutrients needed by preweaned, growing, reproducing, and lactating cattle

The 2001 NRC publication would need to be updated to include a comprehensive analysis of the most recent research findings on amino acids, lipids (saturated and unsaturated fatty acids), fiber (source, physically effective fiber, and particle size), carbohydrates (sugar and starch), minerals (especially trace elements, such as chromium, manganese, copper, and cobalt for all cows; zinc for dry cows; and iodine diets with

and without goitrogens) and mineral excretion, vitamins (fat and water soluble, including choline as a required nutrient), and water.

Nutrition of dairy cattle in different commercially-relevant production systems

A review of pasture and grazing systems, confinement systems, and other commercially-relevant production systems is needed to understand the effects of production-system variation on nutrient requirements and for devising sound nutritional programs. For example, group-fed animals may have different requirements than individually-fed animals. In pasture and grazing systems, which have become more popular in the last 20 years to reduce input costs, the consistency of nutrient intake is less controlled than in confinement systems. Producers and nutritionists could use guidance on how to account for these differences.

Energy utilization by dairy cattle

Energy is vital for tissue maintenance, tissue growth, milk synthesis, and fetal development. A new report that will provide a summary of recent research on energy utilization by dairy cattle, with emphasis on biologically relevant estimates of metabolizable energy utilization for maintenance and reproductive functions, is needed.

Feed intake

Feed intake or dry matter intake (**DMI**) is fundamentally important in dairy cattle nutrition because it establishes the amount of nutrients available to the animal for health and milk production. Feed intake is determined by the interaction of animal, feed, and management factors. The previous NRC report addressed nutrients and feeding management that are related to DMI of lactating cows and cow

behavior, management, and environmental factors that affect feed intake. Up-to-date information on these topics is needed, as well as a review of what is currently known about the relationship of intake, particle size, and ruminal and lower tract digestibilities. An update on digestibility discount coefficients is also needed.

Co-products from the bio-fuels industry

The rapid growth of the ethanol and other bio-fuels industries has resulted in large amounts of co-products that are now being utilized in livestock production. In recent years, studies have been done to determine the nutrient contents of the different types of co-products. The previous edition needs to be revised to include the most current information about the various co-products, their most effective use in the diets of dairy cattle, and the potential limitations of their use based on their phosphorus and sulfur contents.

Environmental impacts of dairy cattle emissions

Public concern about the effects of commercial animal production on the environment has grown over the years. This necessitates a discussion of the effects of nitrogen on water quality and elevated accumulation of phosphorus (from manure applications) in soil and the contribution of dairy cattle methane emissions to climate change. A discussion of animal feeding strategies that can reduce the negative effects of dairy production on soil, air, and water quality without a loss of animal productivity is also needed.

Effect of feeding on the nutritional quality and safety of dairy products

Consumers have become increasingly concerned about the nutritional quality and

safety of dairy products that are in the market. Information is needed on the effect of feeding strategies or certain feeds on milk composition, such as the effect of distiller's grains on milk protein and milk fat or feeding of flax seed and other ingredients on the omega-3 fatty acid content of milk.

New information about nutrient metabolism and utilization

Knowledge about how dairy cattle metabolize and utilize nutrients has continued to expand. A new report is needed in order to address the latest information on metabolism and utilization of various nutrients, including rumen bypass protein, rumen-protected amino acids, lipids, choline, omega-3 and omega-6 fatty acids, and antioxidants.

New information on feed additives and rumen and metabolic modifiers

Feed additives are feed ingredients that produce a desirable animal response in a non-nutrient role, they can be important in improving milk production, herd health, and reproduction. Over many years, a substantial body of work on how changes in feed can reduce methane emissions, especially the use of halogenated hydrocarbons as feed additives, has been assembled. An update of the section on feed additives is needed to include current information on the additives that alter rumen metabolism and post-absorptive metabolism, such as probiotics, prebiotics, synbiotics, ionophores, yeast, tannins, and essential oils and spices, which have gained the attention of dairy producers and nutritionists in recent years. Information on other feed additives that have been found to reduce enteric methane production also would be useful.

Agents that are toxic to dairy cattle

Among the toxic agents that are detrimental to dairy cattle are mycotoxins, which are secondary metabolites produced by mold fungi that occur in many feedstuffs, including roughages and concentrates. Poisoning caused by the ingestion of mycotoxins is called mycotoxicosis. Symptoms of mycotoxicosis in a dairy herd vary depending on the mycotoxins involved and their interactions with other stress factors; stressed cows are most affected, perhaps because their immune systems are already suppressed. A discussion of the effects of mycotoxins, and the prevention and treatment of mycotoxicosis would be an important addition to this report.

Committee Statement of Task

A committee will prepare a report that reviews the scientific literature on the nutrition of dairy cattle and updates the nutrient requirements contained in the 2001 NRC publication *Nutrient Requirements of Dairy Cattle*. The report will contain a comprehensive analysis of recent research on the feeding and nutrition of dairy cattle, including research on the amounts of amino acids, lipids, fiber, carbohydrates, minerals, vitamins, and water needed by pre-weaning, growing, reproducing, and lactating dairy cattle.

The committee will evaluate new information to improve the accuracy of predicting animal performance from nutrient input and of predicting nutrient input when animal performance is known. Consideration will be given to variables that may affect nutrient requirements, such as environmental conditions and type of production system. The report also will address the effects of mycotoxins and other toxins; recent research on energy utilization by dairy cattle; the composition of feed ingredients, mineral supplements, and feed additives

routinely fed to dairy cattle; co-products from the bio fuels industry; and the accuracy of estimating energy in forages using the NRC prediction equation.

New information about nutrient metabolism and utilization; antioxidants; effects of feed grain processing on starch rate and site of digestion; feed additives that alter rumen metabolism and post absorptive metabolism; and rumen and metabolic modifiers will be included. The committee will also review nutritional and feeding strategies that minimize nutrient losses in manure and reduce greenhouse gas production and include a discussion of the effect of feeding on the nutritional quality and safety of dairy products. Future areas of needed research will be identified. Depending on the extent of new information available, an update of the current computer model to calculate nutrient requirements may be developed. Appropriate testing and analysis of any new model will be conducted.

NRC Plan of Work

1. A committee of approximately 10 prospective members will be nominated to the NRC Chairman for provisional appointment. The committee will include of experts in the following areas: energy nutrition; protein and amino acid nutrition; vitamin and mineral nutrition; nutrient bioavailability; feed composition and feed additives; diet formulation; practical feeding; nutrient excretion and environmental management; and computer modeling.

Individuals nominated to serve on the committee may be drawn from both the public and private sector, and will be selected for the specific expertise and knowledge they bring to the committee. Prospective nominees will be screened for financial conflicts of interest. In accordance with NRC

policy on conflict-of-interest and bias, the committee will hold a formal, closed-meeting discussion and examination of those issues at its first committee meeting. Appointments to the committee are considered to be provisional until any findings of potential conflict are resolved.

2. The committee will convene up to three meetings to gather information, hear from experts, and prepare its report. At its first meeting, the committee will hear from sponsors and other stakeholders and users of the report and the model to consider how to approach the addition of new information in the update.
3. The committee will work in subgroups between meetings to review the relevant literature, prepare updates to chapters in the report, draft new chapters, and develop a computer model of dairy nutrition. The committee will make recommendations for nutrient requirements as appropriately supported by the literature and the collective expertise of the committee.
4. The committee will prepare a draft report, the goal being a consensus of the committee. The penultimate draft of the report will be sent to anonymous peer reviewers under the oversight of a standing, independent NRC Report Review Committee (**RRC**). Following receipt of reviewers' comments, and guidance offered by the RRC Monitor and Coordinator, the committee will prepare its response to the comments and propose modifications to the document. The report is considered final when the RRC has given its approval to the changes.

5. The findings of the report, once published, will be announced at a scientific meeting. The report will be available for sale by the National Academies Press. The model will be distributed via a website at no cost.

For more information, contact:

Robin Schoen, Director, Board on Agriculture and Natural Resources, National Research Council

Summary

The ADSA Mission Statement reads: The American Dairy Science Association provides leadership in scientific and technical support to improve and grow the global dairy industry through generation, dissemination, and exchange of information and services. ADSA leadership in cooperation with industry co-sponsors will bring the *Nutrient Requirements of Dairy Cattle, 8th Revised Edition* to life several years ahead of schedule with a first of its kind financial mechanism for preparing a revision of NRC 2001. Absent of the action of ADSA, a revision of the 2001 document might not have been considered for another 5 years.

References

National Research Council. 2001. Nutrient requirements of dairy cattle. 7th rev. ed. Natl. Acad. Sci., Washington, DC.



Table 1. Co-sponsors of 8th Edition of *Nutrient Requirements of Dairy Cattle*.¹

Ajinomoto Hearthland
BASF - The Chemical Company
Cargill Animal Nutrition
Elanco Animal Health
Evonik Industries AG
Hubbard Feeds
IFEEDER (Institute for Feed Education and Research)
Innovation Center for US Dairy
Kemin Industries
Novus International

¹Each co-sponsor contributed \$19,600.

