

Summary

Meeting the Challenges of the New Century

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Discussions presented in this volume highlight some of the significant advances experienced in animal nutrition over the past 7 decades. The discussions also outline important roles of animal nutrition for the future. Our nation faces many challenges in the new millennium. From environmental pollution to products of biotechnology, we rely on a science-based analysis of the issues. Solutions to many of the wide range of animal-related challenges require a science-based application of animal nutrition.

When the Committee on Animal Nutrition (CAN) began its work over 70 years ago, half of the U.S. population lived on farms. Our knowledge of nutrition was extremely limited, and the challenges were very different. Only a few vitamins and minerals were identified, and essential amino acids and essential fatty acids were not understood. Progress during this period in developing an understanding of nutrition came about predominately through trial and error.

Today, over 50 percent of the U.S. population live in cities over 1 million in size. This presents exciting challenges, because fewer people understand agriculture, food production, or animal nutrition. However, knowledge of basic

biology is advancing at an exponential rate. Thus, research in animal nutrition can be largely based on knowledge of biological principles and fundamental concepts rather than a trial and error approach.

Food products derived from animals are important components of human food production throughout the world. The CAN reports have played an important role in providing scientific-based information on the nutrient requirements of animals and the nutrient composition of feedstuffs. Reports have been translated into five languages, and their use represents a key element in providing for the needs and well-being of animals. Their present value and future potential can be broadly divided into five topics - sustainable agriculture, food safety and public health, animal welfare, environmental quality, and international trade and development.

SUSTAINABLE AGRICULTURE

Agriculture is and will always be a vital industry because of our need for a safe, high quality, affordable food supply. Animals and knowledge of animal nutrition are key components to an integrated farming system. At the individual farm level, animal nutrient needs are of critical importance in the development of whole farm nutrient management programs. At the industry/farm level, animal use of nutrients represents a key component in utilizing food industry byproducts and the formulation of a "system" nutrient management program.

The CAN reports provide the latest nutritional information so that various feedstuffs and byproducts can be considered on an individual farm basis and utilized in formulating balanced diets for livestock. For example, even now, 25 percent of poultry and swine diets and 50 percent of Florida dairy cattle diets are byproducts from human food and fiber industries. In fact, a few years ago Anheuser Busch proudly advertised that their distiller's grains were used in the diets of ruminants, which represented an effective part of their waste recycling program. The use of byproducts as animal feeds is expected to increase in the future and will continue to be an important component in the food industry's nutrient management programs.

FOOD SAFETY AND PUBLIC HEALTH

Feeding animals appropriately improves their ability to produce high quality food products. The composition and nutritional quality of milk, eggs, and meat can all be affected by the diet the animal consumes. For example, if an animal is fed a diet that is inadequate in certain vitamins, then the vitamin content of food products from those animals will also be below normal.

When animals are adequately nourished, their resistance to disease also improves, which reduces the potential for animal pathogens that might adversely affect public health. Improving animal health through nutrition also decreases the need for drug treatments, which reduces the potential of drug residues. Thus,

feeding animals adequate amounts of a well-balanced diet represents an important consideration that impacts our food safety assurance system.

Niche markets and organic foods are developing areas in food production. In some cases, the specialized requirements for niche markets raise special challenges in meeting the animal's needs and providing for its well-being. Practices used to create these foods need to carefully consider the animal's nutritional requirements and the nutrient value of feedstuffs to provide adequately for the health and welfare of the animals and ensure quality of the food products is maintained.

Future changes in animal care, modifications in housing design, and improvements in management systems will all impact nutrient requirements. Food production systems are gradually shifting to larger, more concentrated operations, and this offers new challenges. For example, this presents the potential for a biohazard to involve a much greater number of animals. A sound nutrition program is essential to decrease the potential for rapid spread of disease among animals on a single farm or many farms. Thus, applying current knowledge of nutrition to optimize animal health and disease resistance is essential.

Basic nutrient requirements of animals used in food production will also need to be continually evaluated as scientists create "designer foods." Identifying microcomponents of foods associated with beneficial health effects is a growing emphasis often referred to as "functional foods." An understanding of the biology in this area will allow researchers to make modifications to increase the concentration of these microcomponents in food products derived from animals. One example is formulating diets that enhance the concentration of omega-3 fatty acids in animal products. Another example is to feed and manage animals so that concentrations of conjugated linoleic acid (CLA) in milk and meat are increased. CLAs are potent naturally occurring anticarcinogen and the National Research Council has pointed out that they are the only fatty acids known to unequivocally inhibit cancer in animal models.

ANIMAL WELFARE

Predicting animal nutrient needs more precisely improves animal welfare. In particular, it allows better diets to be provided to animals, which is beneficial to well-being and disease resistance. The CAN reports provide users with a better understanding of nutrient requirements and will continue to advance the care of food animals, exotic animals, laboratory animals, and companion animals.

Improving diet quality is critical for the conservation of threatened or endangered species. Proper nutrition is essential for growth and well-being, as well as normal reproduction and perpetuation of the species. In fact, Charles Darwin, in his classic research on the origin of the species, was among the first to recognize that reproduction was severely compromised when the food supply was inadequate. In addition to the supply of food, a correct nutrient balance is

essential, and identifying these needs in exotic animal species is a rapidly evolving area.

Animals used in any type of research, whether at universities, medical laboratories, the USDA, the NIH, or in outer space, need to have adequate nutrition to ensure tests of biological hypotheses are valid.

Animals providing public service such as “seeing eye” or military dogs need to have proper care. Americans are increasingly conscious of the importance of nutrition in maintaining their own health and the health of their companion animals. CAN reports are a critical resource for veterinarians so that proper nutrition recommendations can be made to their clients.

ENVIRONMENTAL QUALITY

The goal for producers and farmers is to carefully manage animals so that a high productive efficiency is achieved with minimal environmental impact. Feeding animals adequate amounts of a well-balanced diet will allow the animal to maintain productive efficiency while reducing the excretion of excess, unutilized nutrients that may have adverse environmental impacts. For example, reducing animal waste content of nutrients such as nitrogen, phosphorus, copper, and selenium is beneficial in protecting soil and water quality and enhancing the sustainability of animal agriculture.

Animal nutrition must be a central component of the Environmental Protection Agency’s guidelines for animal production systems. And CAN has a tremendous amount to offer. Formation of guidelines and standards requires scientific evaluation and recommendations, together with a balancing of the needs of industry and the environment. It is important for the Environmental Protection Agency and National Research Council to work together and share expertise in animal agriculture to ensure that environmental pollution is minimized.

INTERNATIONAL TRADE AND DEVELOPMENT

The potential for growth in animal exports is well recognized because of recent trade liberalization created by the North American Free Trade Agreement (NAFTA) and the General Agreement on Tariffs and Trade (GATT). The world market for animal products is expanding, and the competitiveness of the United States will depend on meeting nutrient needs to optimize animal productivity.

Reports by CAN on nutrient requirements are used throughout the world. Thus, the series of CAN reports have played a central role in global transfer of nutrition-related technology. US researchers visiting developing countries often take along CAN reports, because they are eagerly sought by scientists and applied in their countries. The ability to predict an animal’s nutrient requirements under varying environmental conditions and resource availability enables producers around the world to better manage and care for their livestock.

FINAL THOUGHTS

While CAN reports have been of tremendous value, the shifting paradigms of technology offer exciting challenges and opportunities for the future. Dynamic models of animal digestion and metabolism allow greater precision in developing animal requirements and make the reports of even greater value. The swine publication is the first National Research Council publication of this type, representing a dynamic metabolism model based on amino acid ratios. As a result, amino acids are used more efficiently with less amino acids oxidized and less nitrogen excreted in the animal waste. The new dairy report has a dynamic model of rumen digestion. The challenge with ruminants is to optimize ruminal degradation rates for dietary protein and carbohydrate fractions, to allow maximal utilization by the rumen microbes. Other advancements will undoubtedly lead to improved measures of animal well-being and CAN reports will play an important role in their application. For example, research has shown how nutrient status impacts the endocrine system in the modulation of the somatotropin/insulin-like growth factor axis. These interactions involve a key role for specific nutrients in the regulation of gene expression for processes associated with maintenance of animal well-being.

Recent developments in biotechnology and their application to animal agriculture require that nutritional implications be continuously assessed. For example, lysine is often the limiting amino acid in feedstuffs used for animal diets. Recombinant DNA technology can produce enzymes that could be used as dietary supplements to increase the bioavailability of lysine. Genes for lysine biosynthesis can also be inserted into microbes that become microbial fermenters to produce crystalline lysine for use as a dietary supplement. Other groups of scientists are working to enhance plant lysine content, and genetic engineering also could be used to produce farm animals with the ability to synthesize much of their own lysine requirement. All of these examples are actively being investigated. Each impacts the nutritional requirements of animals, but in slightly different ways. Biotechnology also offers the opportunity to develop other dietary additives. For example, if phytase can be added to diets to improve phosphorus availability, then phosphorus losses in animal waste could be reduced. Additional dietary additives that can be produced by recombinant DNA technology have the potential to enhance rumen microbial fermentation processes thereby increasing the animal's productive output per unit of resource input.

CONCLUSIONS

The Committee on Animal Nutrition of the National Research Council's Board on Agriculture and Natural Resources has overseen the preparation of reports relating to over two dozen animal species. These nutrient requirement reports will continue to be critical in scientific investigations, serving as the reference basis in the conduct of public and private research with animals. The reports are also valuable for educating the next generation of students and

alog/10299.html Industry personnel about the science of nutrition and the principles of a sound animal nutrition program. Further, CAN reports will continue to be a central component in outreach programs to improve the care of farm animals and companion animals. Extension agents indicate that providing an adequate and balanced diet continues to be a major element of feeding programs where compromises occur in the management and care of animals.

CAN has 70 years of impressive accomplishments and successes. This is truly a record that CAN participants, the Board on Agriculture and Natural Resources, and the National Research Council can be proud. The science of nutrition is evolving and expanding in its relevance and importance. Sustainable agriculture, food safety and quality, animal care and well-being, environmental quality, and international trade and development are all areas where the reports from the National Research Council's CAN have played a vital role. Clearly, CAN reports will continue to be a key element in the efficiency, health, and well-being of animals and humans throughout the world.