
Since the first observation of the 4 chambers and subsequent identification of microbial communities within the rumen and the microbial diversity under different dietary environments. Increased understanding of these changes in microbial communities could result in increased microbial growth rates and enzyme secretions in the rumen, resulting in increased digestibility, nutrients delivered to the small intestine, and animal production and efficiency. In addition, increased understanding of molecular-level adaptation of ruminal epithelia and gastrointestinal mucosa may provide the physiological basis for their role in regulation of ruminal pH and nutrient transport. Recent advances and continued study in the area of ruminal fermentation and digestive physiology have the potential to positively affect animal production, health and the environment.

Key Words: digestive physiology, ruminal fermentation, ruminant nutrition

304 Carbohydrates and fat: Considerations as energy and more. M. B. Hall*1 and M. L. Eastridge, USDA Dairy Forage Research Center, USDA-ARS, Madison, WI; Department of Animal Science, The Ohio State University, Columbus.

Historically, carbohydrates and fats were valued on their caloric contributions to diets. Feeding recommendations for these feed fractions now address inclusion levels as well as consideration of the positive and negative effects of specific types of these nutrients. Feed carbohydrate characterization has expanded beyond fiber and nonfiber carbohydrates (NFC). Fiber now encompasses ADF, NDF, physically effective fiber, and fiber digestibility to describe the effect on diet composition, rumination, rumen fill, potential fermentability, and nutrient contribution. The NFC is now parsed into sugars and fructans (both in water-soluble carbohydrates), starch, pectins, and others, all of which may differ in their effects on rumen pH or support of microbial growth. Dietary fat has the advantage of providing energy without increasing the risk of ruminal acidosis. However, there are specific considerations for amounts and types fed in high vs. low forage diets. Fats can affect ruminal fermentation, having the potential to depress fiber digestion or affect ruminal methane production. Considerable research in recent years has focused on providing specific dietary fatty acids (FA) to alter the metabolic function of specific tissues or to alter the FA content of milk for nutraceutical purposes. Rising grain prices and diversion of fats for biofuel are driving livestock industries to seek alternative nutrient sources. Most of the nutritional research on which current recommendations are based involved the use of traditional diets which tended to be rich in grains. Fat and carbohydrate feeding recommendations may need to change with diets high in low starch byproducts. We need to learn how diets with substantially more byproduct feedstuffs ferment, and pass from the rumen, and how they affect nutrient supply and feed efficiency. We can then better predict digestion and the effects on metabolism and efficiency. In addition, increased understanding of molecular-level adaptation of ruminal epithelia and gastrointestinal mucosa may provide the physiological basis for their role in regulation of ruminal pH and nutrient transport. Recent advances and continued study in the area of ruminal fermentation and digestive physiology have the potential to positively affect animal production, health and the environment.

Key Words: carbohydrate, fat, ruminant
methods to quantify degradation and biosynthesis of protein within the rumen, insufficient knowledge about post-ruminal availability and amino acid needs for various metabolic functions, inconvenience of preparing or delivering diets customized for animal groups with different needs, and unrestrained expectations. Much of the dietary N need for ruminants is met by proteins inherent in energy sources fed (grains, forages, and byproducts). No response to improved protein status should be expected if a diet already yields optimum performance! Experimental designs testing applicable concepts often lack appropriate controls. Commercial successes in protein nutrition have been limited to 3 areas – physical or chemical modification of feeds to alter degradation of dietary protein, NPN products with attenuated ammonia release, and ruminally protected amino acids. Future improvements in protein nutrition likely will come from targeted, small-package supplements or boluses that alter the native microbial population within the rumen or rumen function, not from feedstuffs customized for ruminants or inoculation with novel microbes. New DNA sequencing methods are improving our comprehension of changes in the rumen microbiome. Ruminally protected amino acids could be supplemented more precisely if needs for absorbed amino acids were defined quantitatively, but metabolic requirements should parallel those of non-ruminants for maintenance and production. More practical and economical advancements would be expected from enlightened research about and manipulation of numerous factors to increase the post-ruminal protein supply through a decrease in ruminal proteolysis or an increase in microbial protein synthesis within or flow from the rumen.

**Key Words:** protein, microbiome, rumen-undegraded protein

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Mineral and vitamin nutrition in ruminants. J. W. Spears*, North Carolina State University, Raleigh.

Requirements and factors that affect dietary requirements for several trace minerals and vitamins in ruminants are still poorly defined. Most B-vitamins and vitamin K are believed to be synthesized by bacteria in the rumen in adequate amounts to meet the animal’s requirement. However, several studies indicate that supplementing high producing dairy cows with approximately 20 mg biotin/d can reduce hoof lesions and lameness, and in some instances increase milk yield. The vitamin E requirement for optimal immunity and health in receiving cattle and transition dairy cows continues to be an area of interest, with responses to supplementation varying greatly. Macromineral research in recent years has focused primarily on P and S. Studies clearly indicate that P requirements of cattle are lower than those recommended 20 years ago. Because of increased use of ethanol by-product feeds that are high in S, considerable research has been conducted to determine the effects of high dietary S (in feedstuffs and water) on performance and incidence of polioencephalomalacia. Requirements for certain microminerals are affected by antagonists. Sulfur and Mo are important Cu antagonists that can greatly affect dietary Cu bioavailability, and therefore, requirements. High dietary Fe, when present in a bioavailable form, is a potent Cu and Mn antagonist. Recent research suggests that NRC recommendations for Co and Mn may underestimate requirements. In the past 3 years Cr (in the form of Cr propionate) has been permitted to be supplemented at a maximum concentration of 0.50 mg Cr/kg DM to cattle diets. Chromium enhances insulin sensitivity and responses to supplemental Cr appear to be greatest under conditions of stress (i.e., transition dairy cows, receiving cattle), where insulin resistance commonly occurs. Research continues to increase the understanding of mineral and vitamin requirements of cattle in different production systems.

**Key Words:** mineral, vitamin, ruminant