

Ten Most Important Nutritional Developments in the Last Ten Years

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Introduction

Advances in the nutritional science, for many of our production livestock and recreational livestock, have been varied, and in most part cross species. In some cases the nutritional developments are re-invention of existing technology or information, in other cases the developments are novel and create new challenges. Selection of just ten items that pertain to as many of our individual species has been an interesting exercise. A list of significant nutritional developments for any one species could be rather long. This discussion of the ten most important nutritional developments is my opinion only and certainly leaves room for any other topics. The items that are listed below are in no particular order.

National Research Council Nutritional Requirements of Livestock

The NRC nutrient recommendations form the basis for much of the nutritional information and many of the recommendations that are utilized on a daily basis. The NRC publications for each species indicate the current knowledge and understanding of the science of nutrition. The nutritional requirements for beef cattle have been revised in both 1996 and 2001, likewise the dairy cattle NRC was revised in 2001. More recently the horse NRC was revised in 2006, while the small ruminant NRC (sheep, goat, llamas, etc.) was more recently revised in 2007.

The NRC publications for the species of interest often contain many of the same general areas. Dry matter intake is the key to adequate nutrition for all species. The NRC address predication equations and factors that affect dry matter intake. All of the NRC publications address energy and protein requirements from a factorial standpoint indicating the needs associated with maintenance, lactation, gestation, and activity. Vitamins and mineral requirements, functions, bioavailability and metabolism are covered in all NRC publications. Likewise the requirements and metabolism of water are addressed for all species. More recently the dairy cattle and horse NRC include chapters that specifically address carbohydrates and fat feeding and metabolism are included. Both carbohydrate and fat chapters are new as a result of the increased knowledge base, feed technology, and feeding opportunities associated with carbohydrate fractions and fat supplements. Additionally, the dairy cattle, horse, and small ruminant include chapters that address metabolic disorders often associated with nutritional status or feeding management. Possibly the most important aspect of the NRC publications are the nutrient requirement tables for different classes and level of production for each species. Each NRC publication also includes feed composition tables that list book values for many of the common feedstuffs available for utilization by each species.

Ruminant By-product Feed Ban

Prior to 1996, the Food and Drug Administration (FDA) allowed ruminant feeds to include ingredients that were derived from ruminant animals. The advent of the Bovine Spongiform Encephalopathy outbreak in the United Kingdom prompted the FDA to initiate a ruminant by-product feed ban. The feed ban eliminated by-product feeds that were derived from ruminants to be re-fed to ruminant animals. The feed ban's objective was to eliminate from the feed supply materials that could carry the infectious agent (prions) of BSE. Implementation of the feed ban eliminated feedstuffs such as meat and bone meal, bone meal, and products derived from banned materials. While the ban has been in place for a number of years and the feed industry has adapted well, the ban initiated a need for an alternative means of disposal for the by-products associated with the rendering industry. The feed ban has been successful at virtually eliminating and preventing the incidence of BSE in the United States because of its implementation and enforcement. More recently, additional regulations from the FDA have been enacted to strengthen the prevention of any material that may harbor prions from entering the animal or human food chain.

Protein Nutrition/Amino Acid Feeding

As our knowledge and understanding of animal metabolism increases the opportunities for strategic feeding of certain feedstuffs or ingredients expands. In several cases as we ask more from the livestock that we utilize, the more precisely we as nutritionist and animal managers have to be in providing the correct type and amount of nutrients to the animals. Two such cases include dairy cattle and high performance horses. Dairy cattle have been selected to do one thing, and do it well which is producing milk. As a result, the nutrient requirements particularly those of protein are becoming better defined with time. One of the particular areas of increasing development is the application of amino acid feeding/balancing for lactating dairy cattle diets. Dairy nutrition has moved past the point of supplying just crude protein to the cows in the milking herd. First, second, and even third limiting amino acids to production are being identified and included in the diets of high producing dairy cows in an attempt to meet the incredible nutritional and metabolic demands associated with milk production. Supplementation of amino acids to high performing horses is no different. Just as we understand that elite athletes require special nutrition, so does the athletic horse. Physical exertion experienced by high performance horses requires adequate fuel for muscular metabolic activity. Supplementation of specific amino acids to target improved performance and to facilitate recovery after activity is increasing. As our understanding of specific nutrient requirements increases our opportunity to strategically supply those nutrients to our animals will increase. Strategic and timely supply of the correct balance of nutrient should improve animal and nutrient use efficiency.

Beta-Agonist Supplementation

Recently, Elanco has offered a beta-agonist (ractopamine hydrochloride) for the use in finishing cattle diets marketed under the name Optaflexx. This compound is similar to the Paylean product approved for swine production. The beta-agonist work is to increase the deposition of lean tissue (muscle). Beta-agonists are not "re-partitioning" agents in that they increase muscle deposition at the expense of fat deposition. Rather,

beta-agonist stimulates the accretion of lean tissue mass at a greater efficiency and rate, while fat deposition still occurs. Optaflexx is fed during the last 28 to 42 days of the finishing period. The theory behind the use of beta agonist is that increasing lean tissue deposition which weighs more than fat will increase the efficiency of cattle at a time in which finishing cattle are routinely decreasing in gain efficiency. The product claim of Optaflexx specifically is that it increases final live weight, carcass weight, and red meat yield. Field trials have demonstrated that inclusion of Optaflexx has little to no negative impact on meat quality. Optaflexx could be considered on par with ionophores and implants for its' effect on production and management of feedlot cattle.

Co-Product Feedstuffs

The expansion and incorporation of the co-products of the feed grain and food processing industry into livestock diets has exhibited huge growth in the recent decade. Co-products are not new; they have existed for a long time. Of interest is the expansion of accessibility and the sheer volume and types of co-products. It's not news that the ethanol and bio-diesel industries are in a major expansion phase. The appearance of plants that are utilizing cereal grains and oilseeds bring with them the opportunity for abundant co-products. Ongoing research at land-grant universities and private industry are expanding our understanding of the levels of inclusion, variation in composition, and impacts on metabolism that accompany the greater utilization of these products will bring. Likewise, as the cost for the base grains (corn, soybeans) that the co-products originate from increase, producers will increasingly look to co-products to fill the void that higher priced feed ingredients leave.

The challenging aspect to the utilization of co-products lies in the variations associated with the feedstuffs. Variation in the actual chemical composition is one of the primary concerns. The variation in chemical composition is affected by any number of factors: processing plant, raw material variation, processing method, processing day, and any number of other factors. Additionally, variation occurs in the price of these co-products depending upon: seasonal supply, distance from to the plant, ability to handle bulk shipment, and the level of processing or drying applied to the co-product. As the technology of the grain processing develops the co-products as we know them will evolve. Already ethanol production technology is progressing to extract even more of the starch and ultimately the utilization of the oil in distiller's grains may move to the biodiesel industry resulting a very different product than we currently have. An additional challenge created by co-products is the by their very nature they tend to concentrate nutrients, particularly minerals and protein. Mineral imbalances associated with cereal grain co-products are an important consideration when including co-products in the diets of our livestock. Increasing regulatory oversight on the application of animal manures onto land could eventually lead to limitations on the amount of type of co-products utilized on livestock enterprises. Finally, the increasing availability but also the concurrent increase in demand for many of the current co-products will lead to expansion of the use of other products as supplement or ingredients.

Rumensin Approved for Dairy Cattle

The ionophore Rumensin has been available for use in beef cattle for decades, however just last year the FDA approved and expanded the use of Rumensin for dairy cows and heifers. Rumensin, like other ionophores, functions in the rumen by altering the microbial population to improve the efficiency of use of the diet. Additionally, Rumensin offers the opportunity for reduction of metabolic disorders and controlling protozoal parasites. In beef cattle, the improved feed efficiency translates to improved gain. In dairy cattle, the label claim is an improvement in milk-production efficiency (more pounds of milk per pound of feed consumed). Dairy producers now have the option to include Rumensin in either TMRs or in component-feeding systems. These systems include supplements that are fed in the parlor, in electronic feeders, or as a topdress. The minimum-feeding rate for these supplements, which can be fed both to dairy cows on pasture and dairy cows in confinement, is one pound per head per day.

The FDA also has expanded the Rumensin label to allow feeding to dairy replacement heifers that are raised in drylots. Previously, Rumensin was approved for use in pasture raised dairy heifers only as a means to increase live weight gain and control coccidiosis. The inclusion of Rumensin for drylot scenarios means that program-fed heifers can now benefit from the inclusion of an ionophore in their ration.

Nutriceuticals

This is a term that I heard as a graduate student and have heard more often since. Nutriceuticals are feed ingredients or feedstuffs that are included in a ration to provide both a nutritional benefit and some extra nutritional benefit. Many ingredients that we may now consider routine could be classified as nutriceuticals. Some of the prime examples are the inclusion of fats in diets of many of our livestock species. Particularly the inclusion of many of the oils, fats, and fatty acids are purported to have nutriceutical properties. Omega-3 fatty acids are one example of the fat products that are included in many rations and feed formulations to provide an extra health benefit. Other ingredients that fall into this category would include some of the chelated minerals, plant extracts, yeast products, and active compounds. This area has seen some limited growth in ruminant animals, but in horse rations this area has seen a dramatic increase in products and applications. A primary driving force behind the marketing success of these products is particularly in the recreational equine area is our desire to treat our horses like ourselves. Inasmuch as our horses are often long-term companions so their well-being and comfort becomes a priority. Thus many of these products are marketed to affect issues like joint health, hair coat quality, and nutrient availability.

Animal Waste

Recent attempts in the US Congress to declare animal manure a hazardous material, underscores the importance of dealing with animal waste. Manure is the place where many of the excess nutrients not utilized by the animal are concentrated. This concentration of nutrients, particularly nitrogen and phosphorus has led to the regulation of manure application in many areas. The regulation of animal manure then becomes a nutritional issue as we try to optimize animal performance by supplying adequate nutrients to meet production goals, but minimizing the amount of nutrients that are

excreted in the manure. Developments to increase the digestibility, absorption, and utilization of nutrients are prime areas of research and development. Additionally, continued review and refinement of the recommendations of feeding levels for certain nutrients of environmental concern is ongoing. Required levels of protein and minerals in diets of beef and dairy cattle are routinely assessed.

Associated with the manure issue is Concentrated Animal Feeding Operations (CAFO). Regulations related to CAFO dictate the number of animals per unit of land area and often include manure disposal regulation. In some cases our smaller producers could potentially run into CAFO regulation issues because of the number of animals on their smaller land holding. Waste management systems for farms of all size is and will continue to be an issue to be addressed by production livestock and recreational livestock enterprises as the public and agriculture sector become more aware of the potential impact that animal production may have on the environment. Likewise, the success stories of good nutrient management and land stewardship have to be emphasized.

Feedstuff Processing

In addition to the increase in the number of feedstuffs available for all classes of animals, the ability to further process feedstuffs has increased. Further processing of available feedstuffs has increased the nutrient availability and utilization of the feedstuff. Processing methods like pelleting, extruding, and steam-flaking are not novel to the last ten years. What is important is the application to feeding of livestock species over the last ten years. Beef feedlots in the High Plains have expanded their utilization of steam-flaked corn and sorghum as a means to increase the utilization and feed efficiency of finishing cattle. Pelleting technology evolves continually. Increasingly pelleted products offer the attractive option of combining micro-ingredients with carrier ingredients into a pellet to ensure the desired level of intake. Pellets offer the opportunity to custom blend multiple ingredients into a single feed to ease batch mixing for beef, dairy, small ruminant, and horse diets. Finally, pellets combine ingredients that may otherwise be small and dusty into a product that can be handled easier and produce less undesired results. Additionally, the increase of the use of pelleted complete feeds for horses has increased recently for many of the reasons stated previously. Extruded and texturized feedstuffs represent advances in feed technology to increase palatability of feeds for animals.

Computers and the Internet

Today, the world seems to revolve around the use of computers and electronic technology to accomplish even the simplest of tasks. The computer and internet access have had huge impacts on the field of animal nutrition, even though computers were utilized ten years ago for nutritional matters. The ability of everyone now to have ration balancing software or programs is nearly unlimited. The internet allows access to a spectrum of different sources of information. Downloadable programs to manage forages, feedstuff, ration balancing, and nutrient management are available to the animal producer at the click of a button. This opportunity for information is in contrast to the process not so long ago of relying on consultants to provide that technical expertise. Every university extension system, company, and allied industry has a web presence that

supplies information. With this access to nearly unlimited information comes the opportunity for producers to make better and more informed decisions about management and nutritional issues. If nothing else, the information available to producers provides them with enough information to ask specific and sometimes rigorous questions to specialists in the field of nutrition. Likewise, the internet is full of information of dubious validity or half-truths that exist as pitfalls to the unwise. Computers and the internet offer opportunities for animal owners of all sorts to interact and exchange information and ideas that is unprecedented.

Others Worthy of Consideration

Development of non-toxic Endophyte Fescue
Grass-fed / Natural / Organic feeding systems
Organic Minerals
Dietary Cation Anion Difference

Conclusions

I started by saying that this list could be debated and leaves plenty of room for other developments. The nutritional developments listed here have had an important impact on nutritional science. Additionally there are many related developments that impact nutrition and nutritional management of our animals. Genetic advancement has a huge implication on the way animals are fed and managed. For our production livestock (beef, dairy, meat type small ruminants) end product will continue to shape the way that we manage and feed our animals. For horses, as our expectations and desires for improved performance and longer productive life increases so will the need for nutritional advances to support the equine animal. Nutrition is one of the core functions that support all other aspects of animal production, from reproduction to health, adequate nutrition is required for adequate performance.