Basic dairy and beef nutrition principles for the new graduate

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Abstract

Ruminant nutrition is often considered a difficult and complex subject in the minds of veterinary students. This may be due to the lack of nutritional training in veterinary colleges, the lack of exposure to agriculture, or because nutrition is considered a separate career practiced by a nutritionist. Nutrition doesn't have to be complicated. The purpose of the nutritional program is to provide safe feed that meets the cow's nutritional requirements. Veterinarians have an intricate knowledge of ruminant health and a well-developed problem-solving skillset. These attributes make the veterinarian highly capable of consulting with clients regarding nutritional concepts. The goal of this session is to demonstrate to aspiring veterinarians that nutrition is simple in concept and can be easily implemented in clinical practice.

Key words: nutrition, forage, student, beef, dairy

Introduction

New graduates in a group practice often find, and are even encouraged in, a specialty field within bovine practice. This is a great way to build a reputation and bring value to a team. Example interests include advanced reproductive services, milk quality, youngstock health, among many others. While farm management styles vary tremendously between each operation, all cattle feeding operations have in common the single fact that they must feed their cows. In the author's opinion, nutrition has perhaps the largest impact on cattle health and farm profitability. Veterinarians are frequently asked to examine cows and correct problems that have a nutritional basis. Furthermore, livestock producers have come to expect their veterinarian to have a working knowledge of nutrition. Using basic senses and the power of observation, veterinarians can engage in relevant conversations with herd managers and nutritionists about the overall health status of a herd.

What a cow needs to eat

Perhaps the best place to begin in the topic of cattle nutrition is with the question, "What does a cow need to eat?" There are excellent guidelines for dairy cattle published in the National Requirements of Dairy Cattle (NASEM 2021)[1] and for beef cattle in the National Requirements of Beef Cattle (NRC 2016).[2] These textbooks contain the latest guidelines for the nutritional requirements of cattle based on age, weight, life stage, environment and production history. Cattle have requirements for energy, protein, minerals and vitamins. However, feed ingredients are not identified in these texts. This is because cattle do not have ingredient requirements; they have nutrient requirements. It is up to the feeding operation to determine which feedstuffs to provide the cows to meet their requirements. How do feed managers decide which feeds best promote health and productivity? To answer this question perhaps we should first ask, "What is a cow designed to eat?"

Cows are designed to eat forage. The digestible fiber and amino acids in forage best feed the microbial population in the rumen. The microbes convert these substrates to bioavailable protein and energy for the cow to use to meet her needs. If our goal is to feed cows a diet that promotes them to be healthy, produce well, and live a long time, then it is in our interest to feed a diet that consists of the best quality forage we can provide. This is what she is designed to eat. Concentrates are fed to make up deficiencies and supplement the diet when production demands are high. Byproducts are a resourceful addition, but they can only safely replace a portion of the total forage in the diet.

How to produce high-quality forage

Not all forages are equivalent. Forage quality is defined as the ability of a given forage to meet the nutrient requirements of the consuming animal.[3] In other words, the quality of the forage is interpreted in respect to the animal that is consuming it. High-producing Holstein cows have higher nutrient requirements than their non-lactating counterparts.[1] In the same way, an Angus cow nursing a growing calf will have higher nutrient requirements than after that calf is weaned.[2] The ideal forage for a lactating cow would be high in digestible carbohydrates and protein, while a quality forage for a non-lactating cow would have sufficient nutrients to meet requirements without allowing the animal to overconsume and become fat. Key measures of quality on a forage analysis include dry matter (DM), crude protein (CP), total digestible nutrients (TDN), neutral detergent fiber (aNDFom), acid detergent fiber (ADF), digestible NDF (dNDF – intervals reported at 12hr to 240hr), and starch. These values should be compared to NASEM/NRC requirements.

Many things can influence forage quality including crop species (grass vs. legume hay), crop variety (brown midrib corn vs. conventional corn), growing season (hot vs. cold, wet vs. dry), maturity at harvest, and storage conditions. While some of these are out of our control, forage maturity is one factor that can be managed.[4] Immature forage is higher in energy, protein, and palatability, while mature forage contains more lignin, is less digestible, and contributes more to rumen fill. Mature crops yield higher but have lower forage quality. Thus, there is a balance between the desired quality and quantity of the forage. The nutrient requirements of the animal should dictate the timing of crop harvest. In the northeast United States, mixed grass/alfalfa crops that are harvested around May 15, then every 28-30 days after, generally yield enough tonnage with acceptable quality to feed high-producing dairy cows. This will vary by geographic location.

Method of storage also has a large impact on forage quality.[5] A high-quality crop can quickly become spoiled if bunk and storage management principles are not followed. The key to making good silage is the exclusion of oxygen. Oxygen promotes aerobic fermentation which results in the consummation of digestible carbohydrates, heat production, proteolysis and dry

matter loss.[6] This reduces forage quality. Anaerobic fermentation produces lactic acid which halts further microbial growth and stabilizes the forage until feedout.[6] While oxygen exposure cannot be entirely avoided, it can be minimized with high packing density (> 14 lbs/ft^3 DM),[7] prompt coverage with plastic tarp (minimum 6 mil),[5] and good face management at feedout with 6 to 12 inches of face removed per day.[8] Forage dry matter is also crucial to a beneficial fermentation. A good target for corn silage stored in a bunk is about 35% DM, but this number will vary based on crop and storage method.[9] If there are challenges to achieving any of these objectives, a silage inoculant should be considered.

Large round bales should be stored under a roof or wrapped with plastic. Hay bales stored outside and exposed to the elements will undergo significant weathering in the outer 6-inch layer.[10] This can comprise up to 40% of bale volume![10] If this loss in DM is not accounted for in ration calculations, then cows will be forced to consume the spoiled feed to try to meet nutrient requirements. Even when excess feed is provided to the herd, it is likely that some cows are consuming spoilage and thus potentially high concentration of yeasts, molds or clostridium.

How to tell that a cow is getting what she needs

There are at least 5 different diets on a farm. There is the ration on paper, the ration mixed, the ration fed, the ration consumed by the cow, and the ration digested by the cow. The digested ration is what the cow experiences, but farm management often only looks at the paper ration when there is a problem. Physical examination of the cow is necessary to determine the actual cow experience. Sight, smell and touch are indispensable tools in assessing cow health and feed value.

In the author's opinion, body condition score is the best way to determine if a cow is responding to the diet. A 5-point scale exists for dairy cattle while a 9-point scale is used for beef cattle.[11,12] The goal of the feeding program is to keep cows as close as possible to an "ideal" body condition throughout their production cycle, while recognizing that certain production phases will be more demanding than others. Cows outside of the normal range of body condition without good explanation should be a red flag that merits investigation. In the same way, youngstock that are smaller than expected could be due to a nutritional deficit.[13]

Fecal consistency is also heavily influenced by diet. Loose or stiff manure throughout a herd should be noted. If infectious causes can be ruled out, the veterinarian should engage in a discussion with herd management about dietary sufficiency. Dry manure tends to indicate dietary inefficiencies of low protein or high fiber, while loose manure tends to indicate excess of soluble nutrients in the hindgut (nitrogen, mineral, carbohydrate.)[14] Both conditions can be costly and potentially harmful to cow health.

Rumination is a strong indicator of a well-functioning digestive tract. Rumination can be observed visually or through an electronic monitoring device. Studies have shown that chewing activity is correlated with the amount of physically effective fiber (peNDF) in the diet.[15] Physically effective fiber refers to the lengthy portion of fiber that forms the rumen mat. Insufficient effective fiber is associated with reduced rumination and subacute ruminal acidosis.[16] A particle size separator box can be used to quantify the fragment length of a total mixed ration. Forages such as hay, straw, and corn silage are typically high in peNDF; soybean hulls, wheat middlings and cottonseed are example fiber sources that are low in peNDF. Guidelines for particle size distribution are published through Penn State Extension.[17] It is important to interpret particle size in respect to the ration on paper and other herd observations.

If physical observations are indicating a problem, forage analysis is an excellent next step into an investigation in a feeding program. Numerous university extension agencies have published guidelines detailing proper procedure for collecting a forage sample.[18,19] It is important to follow them. Approaching a bunk face to collect handfuls of material is not only dangerous but also a poor representation of current forage inventory. Remember that time and money are invested in these samples and future herd health decisions will be based on the results. An inaccurate representation of the forage will be costly and potentially harmful to cow health.

There are many laboratories and test panels available to analyze forage quality. A wet chemistry analysis can be conducted on any feedstuff and is considered the "gold standard" test for accuracy. However, it takes time for the analysis to return and it is moderately expensive. Near-infrared reflectance (NIR) spectroscopy is a fast and inexpensive way to obtain results.[20] One limitation of NIR analysis is that the laboratory equipment must be calibrated to handle that specific feedstuff (most commonly-fed forages are compatible.) Another limitation of NIR is that the mineral measurements are less precise.[21] It is strongly encouraged to develop a relationship with a local laboratory to discuss sample submission, proper handling, and to obtain assistance with interpretation of results.

Conclusion

Livestock producers benefit from veterinary involvement in many ways. This is because veterinarians are well trained to make observations on an individual basis and use them to generate an overall picture of herd health. Equipped with the power of observation, a problem-solving skillset, and a few ancillary diagnostics, a veterinarian is highly qualified to promote cow health through relevant nutritional advice.

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