Perspectives on Nutritional Management of Bison Bulls Fed for Meat

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Summary

Bison evolved consuming only forage. In the short time man has managed these animals, we have changed their diet, especially for animals destined for meat. Several factors affect feed intake in bison. Seasonal changes in eating have developed over time and it is our challenge to work with these patterns in achieving efficient growth. While it is reasonable to include some grain in a ruminant ration, severely limiting forage is not a natural pattern and it is unknown what "side effects" may result. Protein and mineral nutrition are in need of basic requirements research. Until research can document bison rumen function, a conservative approach to feeding is recommended retaining some forage or fiber in diets in bison fed for meat. Granted, we have anecdotal information from feeding bison and base many of our feeding decisions on these experiences. Assembling this information into a useful database may be helpful in directing research or defining circumstances surrounding production problems.

Introduction

All animals require nutrients for two major purposes: maintaining existing body function and for growth. Plant biomass is the basic source of all nutrients. Ruminants have evolved to digest plant biomass using a four-compartment stomach system with the rumen being the largest and most critical. Most of the actual degradation of plant biomass occurs in the rumen by action of bacteria, protozoa, and fungi, of which bacteria are the most important. These microbes break down plant material into the basic molecular forms required by the body for maintenance and growth, primarily fatty acids and amino acids. Nutrient uptake occurs in the lower gastrointestinal tract, primarily the small intestine.

Various strains of bacteria are adapted for fibrous plant material and others are adapted for digesting starches, and for proteins. Optimum digestion occurs with a steady state ruminal environment when microbial populations exist in relative harmony at favorable pH, moisture, temperature, and feed substrate levels. This optimal digestion condition generally requires some fiber for proper rumen function. Bison have somewhat higher populations of cellulolytic (fiber digesting) bacteria than bovines. Greater extraction of nutrients from lower quality forage was observed. Many bison producers have used this evidence and observation as justification for feeding poor quality hay, when in fact, higher quality hay may result in more economical growth. Research is needed to evaluate this hypothesis.

To feed bison for optimum gain necessitates that maintenance requirements be met first, with nutrient intake above maintenance level available for growth. So feed intake and nutrient density (or concentrate level) are critical factors in producing satisfactory and economical growth.

The nutrient density of the diet then becomes an issue. We are seeking an optimum diet with some forage for proper rumination but enough energy to support maintenance and growth. Too much concentrate or starchy grains in the diet may create nutritional stress manifested as acidosis. This condition results from an acid pH (below 6.0 in bovines) in the rumen and may be roughly equated with overindulgence by humans who treat the problem by taking a buffer of some kind. Managing the high grain diets may be a contributing factor as erratic intake caused by several factors is known to be problematic. Ruminants can also benefit from buffers in very high concentrate diets. Sodium bicarbonate is a common product used for buffering diets. It is simpler and more natural to simply feed a little forage or fiber for healthy rumen function.

Feeds available

Several concentrates are available depending on where bison are being fed. Not all grains or co-products are equal. Corn, barley, and oats are the main grains fed and can all be used successfully. Energy decreases as fiber increases. Moist feeds such as wet beet pulp or potato processing co-products may add palatability and serve as desirable concentrates. Beet pulp is an excellent source of digestible fiber while potato co-product is high in starch. Both are modest in protein. Other co-products that may be useful include soybean hulls, high in digestible fiber and 12% protein, barley malt pellets, high in crude fiber and 14% protein, and wheat midds, high in digestible fiber and 18% protein. Wheat and sunflower screenings are used widely but vary considerably from field to field and batch to batch. They may be used in combination with other concentrates at less than ½ of the grain component in the diet.

Physical form

The physical form of concentrate feed animals are first offered appears to be important. Changing from larger particles (pellets) to smaller particles (ground grain) is problematic causing feed refusal, but changing from ground to pelleted is not. Pelleting is expensive and is used by many commercial feed companies to make a uniform and free flowing feed from a variety of ingredients. This form may mask nutrient mediocrity, and is commonly used with high levels of wheat and sunflower screenings.

Processing grains is thought to produce the same advantage in bison as cattle. Rolling or grinding of grains can easily be accomplished on-site if volumes justify the purchase and operation of a roller mill, which is preferred over hammer mills for particle size control in grains. Some dry co-products are pelleted and can be fed as is. Improved gains have been observed with rolled vs. whole grain in 75% concentrate diets.

Feed delivery

The feed delivery system used is probably more related to economies of scale than advantages of a totally mixed ration according to some field comparisons. Totally mixed rations fed in fenceline bunks are favored for larger numbers of bison (> 200 head), adequate labor, and equipment. Self feeders waste more feed, especially hay, and limit control of forage vs. concentrate intake. Self feeder maintenance is important, to insure feed flows adequately, no mold or caking is present, and feeders are filled prior to becoming empty. In remote areas or where limited numbers of animals are fed, this option is viable. Self feeders design and stocking density are factors in how often animals eat, especially the more timid ones. Self feeders with open sides where animals are not "blind sided" are recommended.

Feed intake

Bison seem to naturally self-limit intake with less dry matter consumed per unit body weight than bovines. Bison also consume feed in several small meals throughout the day vs. fewer large meals observed in bovines. This habit maintains a more uniform ruminal environment and may contribute to more complete nutrient extraction by bison vs. bovines.

Feed intake for bison changes with the season presumably due to some evolutionary mechanism that in effect says "eat more in the fall to store up fat for winter, don't try to find feed in the winter because it will take more energy to forage for feed than will be available from the feed you find, eat more in the spring to gain back what was lost during the winter, and eat modest amounts in the summer as the grass is nutritious and other things such as calving and breeding are important." It has been documented that bison physical activity, respiration, heart rate, and metabolism slow down in proportion to cold exposure until extreme conditions are encountered. This seasonal reduction in intake may contribute to enhanced digestion when feed is abundant, commonly called compensatory gain. In other species, intestinal villa were observed to increase in length when high fiber, low nutrient density feeds were fed, thus increasing the total surface area for nutrient absorption and improving feed efficiency. It seems logical to manage bison rations to take advantage of their natural eating habits. Winter feeding strategies may include only modest energy supplementation if poor quality hay is fed or offer a better quality hay, such as native grass harvested during the vegetative stage during the winter. However, there is some evidence that diets with modest grain levels (5-10 lb/hd/day) fed during the winter produce satisfactory gains, especially in milder climates. Cold temperatures and photoperiod may both be responsible for triggering any seasonal patterns but we cannot separate them or practically control them.

The need for some forage and/or fiber in the diet for proper rumen function is antagonistic to maximum gain, which requires high concentrate levels. One approach which may be useful is to use feeds that are high in digestible fiber, commonly considered the hemi-cellulose fraction. This fraction can be determined with a lab analysis of the feed or diet. Laboratory analysis of feedstuffs produces a value for ADF or acid detergent fiber, which is basically indigestible cellulose and lignin, and a value for NDF for neutral detergent fiber. The hemi-cellulose fraction is the difference between the NDF value and the ADF value. Feeds that have a relatively high digestible fiber content need to be included in research trials with high starch grains to confirm this hypothesis.

Anecdotal information and some research trials suggest that high grain diets with corn or barley at 60 to 75% of intake produce optimum gains. Higher grain diets have been fed but the nutritional stress of minimum or no forage rations can be problematic. The value of a warm-up period is important, with 50 days or more providing greatest gains once high grain diets are fed (Rutley et al., 1995).

Describing diets

Formulating and describing diets for ruminants is not simple. Energy concentration can most easily be described in terms of Mcal (mega-calories) per pound. Wintering bison diets on poor quality hay with 2 to 4 pounds of grain may be in the 45 to 47 Mcal/lb range. Warm up or transition diets with 8 to 10 pounds of grain and medium quality hay may be in the 55 to 58 Mcal/lb range. Diets with free choice grain intake and minimal forage will be in the 62-64 Mcal/lb range as bison will consume some forage if offered. Ultimate control comes with totally mixed rations fed in fenceline bunks.

Protein

Protein needs to be treated entirely different in bison diets than bovines. Bison recycle nitrogen efficiently, an evolutionary response to very low protein diets from mature grasses during several months of the year. This recycling may cause high blood urea nitrogen levels from modestly high protein levels in the diet. The specific results of high nitrogen levels is unknown but we do know that it is metabolically expensive in energy terms to deaminate amino acids. Determining maximum and or optimum protein levels is high on the research priority list. In some areas, many feeds contain protein levels higher than many bison producers consider optimum making it difficult to formulate diets. Eleven or 12% protein is considered the maximum from anecdotal experience.

Minerals

Mineral requirements have not been determined for bison. Anecdotal experience again suggests a calcium to phosphorous ratio of 1:1, unlike the 2:1 ratio for bovines. Selenium requirement in bison is thought to be greater than bovines at .02 parts per million (ppm). Mineral nutrition in bison has been based on trial and error experience. Considering the value of bison, it may be practical to offer a complete mixed mineral that includes several micro-minerals including cobalt, copper, iron, iodine, zinc, molybdenum, and others, especially if animals look unthrifty or some undiagnosed problems exist. Minerals are available as inorganic (i.e. sulfates and oxides) or chelated (i.e. proteinates and methionates). The bioavailability of the chelated minerals is thought to be higher but they are more expensive. Local soil conditions may dictate specific mineral formulations to counter deficiencies or toxicities from plant material or water. Interpreting toxicity and deficiency symptoms from bovines may be useful.
