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Grazing Animal Diets: When to Supplement

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INTRODUCTION

Despite the fact that we live and operate in the age of technology, the age old question of precisely when to start or when to end supplementation of grazing animals remains. Often the determination of when to begin and when to end supplementation is not based on sound nutritional and/or economic reasons. Currently no one technology or gadget is available that precisely determines when that window of needed supplementation exists. Tradition and the educated guess method has served to make that decision.

The use of such programs as SPA (Standardized Performance Analysis) has allowed producers to more accurately determine the actual costs of maintaining cows on a year around basis. SPA information has shown that feed costs account for as much as 40-70% of yearly cow costs. Supplemental feeds makes up a significant portion of that amount and producers have become more interested in attaining the most out of their supplemental feed dollars. Two undesirable costs related to supplemental feeding can occur: 1) excessive cost due to overfeeding and 2) costs due to lost production which result from underfeeding.

Efficient supplementation programs require attention to three key factors: 1) determination of the window of need for supplemental feed, 2) determination of the appropriate supplement and 3) determination of the proper amount of supplemental feed. In order to develop an efficient supplementation program for grazing animals and to make the determination of when that supplementation should occur, one must have information in two areas. First, it is necessary to know the nutritive value of the forage being consumed by the animals. Secondly, to know the nutritional requirements of the animals consuming the forage. While, several factors, such as stage of production, sex of the animal, age of the animal and performance goals or objectives influence nutritional requirements, many sources (ex. National Research Council) exist that give reliable guidelines on nutritional requirements for animals. Such guidelines address one of the two above mentioned needs to develop and implement an economically efficient supplementation program. The use and application of the new NRC requirements for beef cattle is addressed by Dr. Ivan Rush in a subsequent paper and presentation.

The purpose of this paper is to address the remaining issue of determining the nutritional value of the forage being consumed by the grazing animals and to review current research on methodologies that address this issue of when to supplement grazing animals.

WHAT THE FORAGE PROVIDES

The weak link in answering the question of when to supplement grazing animals has been

a lack of knowledge regarding the actual nutritional value of the forage being consumed. An understanding of what the forage is providing requires knowledge in: 1) forage intake, 2) forage availability and 3) the actual nutrient content of the forage. Knowledge of these three factors can provide a producer a more accurate picture of whether or not the nutritional requirements of the animal are being met and whether or not supplemental feeding is necessary.

Forage Intake

Research results have shown that nutritive value of the forage impacts intake of the forage by an animal. As nutritive value decreases in the forage, intake of the forage decreases as well. A study by Cochran, 1995 best illustrates this effect. In an examination of 17 different forages varying in protein content from 1.9 - 17.4% and digestibility from 37 - 73 %, intakes varied from 0.5 to 2.9% of body weight. Figure 1 illustrates the changes in intake due to differences in protein content.

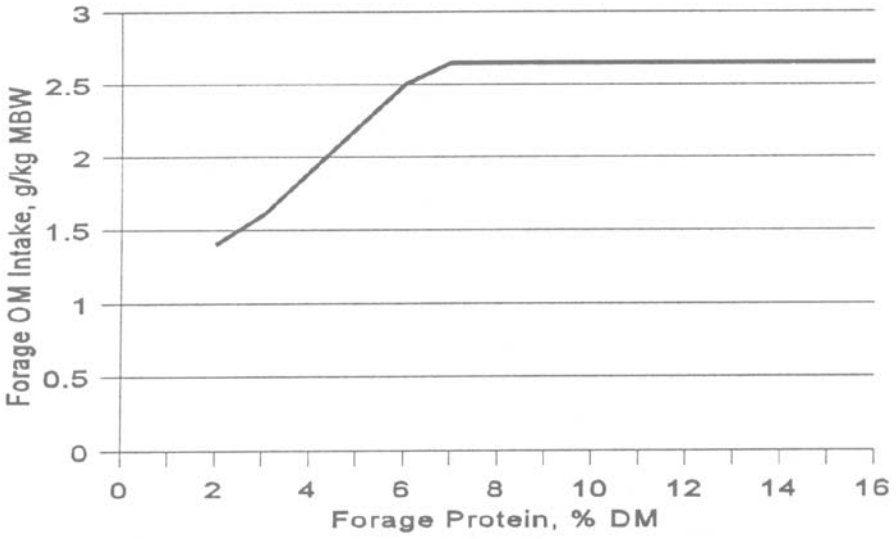

Figure 1. Effects of changes in forage CP content on changes in voluntary forage intake. Modified from Cochran, 1995.

The results reported by Cochran, 1995 indicated that forage intake as affected by protein content decreased at about 6.3% crude protein and continued to decrease as protein content continued to decrease. A similar study by Bowman, et al. (1995), reported similar findings with a point of inflection of about 6.0% crude protein. From these studies one could expect that forage consumption would decrease with forages that have crude protein content of <7.0% protein. Since the energy value of forages is positively correlated with protein content, depressed energy values would be expected as a result of lower forage intakes with lower quality forages. Thus, nutritional requirements for both protein and energy may not be met due to a combination of low nutritional value of the forage and decreased intake.

A variety of methods exist for accurately determining forage intake, however these methods are expensive, time consuming and not practical in a typical ranch setting. Other methods of evaluating forage intake by an animal, that are simple and inexpensive, are currently being studied. The use of fecal samples to estimate crude protein in the diet and blood samples to estimate total crude protein intake are being studied to determine daily forage intake (Kronberg, South Dakota State University, personal communication).

Table 1 illustrates the dry matter intake requirements as suggested by the National Research Council, 1984. These can serve as guidelines for intake required by a 1200 pound cow at various stages of production.

Table 1. Required Dry Matter Intake of a 1200 lb cow at Various Stages of Production.

PRODUCTION PERIOD	INTAKE REQ. (% BW as Dry Matter)
Precalving	1.7 to 2.1%
Postcalving	1.7 to 2.3%
Lactation/Breeding	2.0 to 2.3%
Midgestation	1.6 to 1.9%

Forage Availability

Availability of adequate amounts of forage for grazing animals can also play a significant role in determining the need for or when to begin supplementation. Research indicates that most grazing animals, and especially cattle, are by nature selective grazers. If quantity of the forage is limited then selection by the animal is limited. On the other hand if quantity is not limited then opportunity exists for the animal to select and graze a higher quality diet. A summary of data collected at the South Dakota State University, Cottonwood Research Station in 1991 and 1992 (Namminga et al., 1992) illustrates the potential impact of forage availability on nutrient value of the forage consumed. Cattle grazing pastures higher in available forage were able to select a higher quality diet than cattle grazing pastures with less available forage (Table 2).

Table 2. Winter Range Forage Collected by Esophagal Fistulated Steers

FORAGE NUTRIENT	FORAGE	AVAILABLE
	Low	High
Crude Protein, %	3.73	5.45
ADF, %	57.56	53.54
NDF, %	82.57	80.76
ADL, %	8.21	6.87

Modified from Namminga, et al., 1992, South Dakota State University.

Nutrient Content of the Forage

Nutrient content of forage or forage quality is affected by several factors, some of which include species, stage of growth, soil fertility and sampling procedure. Determination of the nutrient content of the forage being grazed may be the most important step in being able to properly determine the optimum time to begin supplementation or to end it. Three options for determining the nutrient content will be discussed, their advantages and disadvantages.

The first method includes the use of fistulated animals. Cattle fitted with esophageal fistulas offer an opportunity to actually sample what the animal is eating. Researchers for years have used this type of system to more accurately determine the nutritional value of grazed forage. This method removes the problem of selective grazing that cannot be mimicked by humans in attempts to determine forage quality. The disadvantages to this method are many as it relates to practical use by a producer. It is an expensive and labor intensive method for collection and analysis of forage samples. To date, its use has been restricted to research projects and the problem of practicality remains. It's sole advantage over other methods is it's level of accuracy.

A second method for determining the forage quality being grazed is to collect representative clip samples throughout a given pasture for analysis. While this method is less expensive both from a cost and labor standpoint it does have one limitation. While we can observe what cattle appear to be consuming and make attempts to collect clip samples that reflect what they are consuming, typically, we are not as selective and therefore are not as accurate in collection of the clip sample that exactly matches what the animal is eating. Table 3 contains data collected at the SDSU Cottonwood Research Station (Namminga et al., 1992) and compares the nutritive value of grazed forage with samples collected from esophagal fistulated steers versus clip samples.

Table 3. Protein content of forage samples collected in January 1991 and 1992.

		Forage	Available	
	1991	1991	1992	1992
Collection Method	Low	High	Low	High
Esophageal	3.73	5.45	4.68	4.93
Clipped	3.79	5.04	3.57	3.68

Modified from Namminga et al., 1992, South Dakota State University.

Certainly this method offers an opportunity to estimate the forage quality for grazed animals in a relatively simple and inexpensive manner. Understanding the shortcomings of this method and adjusting for it can certainly make this method a useable system in determining that window of opportunity for supplementation. As a general rule, grazing cattle diets will contain about 2 % more crude protein and be about 3-5 % more digestible than clipped samples (McCollum, 1995). Making this adjustment can help add accuracy to determining the actual value of the forage being consumed.

Another technology or system, more recently developed for use in determining forage quality with grazing animals is analysis of fecal samples collected from animals. This system was developed by the Ranching Systems Group in the Rangeland Ecology and Management Department at Texas A&M University. The system analyzes fecal material by using Near Infrared Reflectance Spectroscopy (NIRS) and estimates forage protein and digestibility. The system also includes a nutrition balance analyzer software program (NUTBAL) that aids in ration formulation and prediction of performance for the grazing animal. This system has application in several species of animals including, cattle, sheep, horses, goats and bison. While this system has potential as a valuable tool in use for determining the optimum time to begin or end supplementation, a word of caution is necessary at this point in time. Initial work to develop the system was conducted on a limited forage base in central and south Texas. Since the system is dependent upon accurate calibration and prediction equations, concern exists that grasses in other areas of the country may need to be analyzed with other equations than those originally developed on forages in Texas.

Currently, validation trials are being conducted around the country in an effort to determine what if any adjustments need to be made in the equations to be able to more accurately predict forage quality for a given area or region. South Dakota State University in cooperation with the Natural Resource Conservation Service is conducting validation trials on the system and has just completed the second year of a three year evaluation of the system for this part of the country. Table 4 contains data comparing protein analysis by more conventional lab techniques from fistulated steers versus fecal analysis for protein from the same steers. The data illustrates the concerns regarding development and use of correct calibration and prediction equations by NIRS.

Table 4. Effect of date and method on crude protein of forage.

METHOD	12/14	2/7	4/11	4/24	5/6	5/21
Kjeldahl	6.0	5.7	7.4	8.9	9.2	10.0
NIRS	4.7	3.6	5.8	5.5	8.2	8.2

Modified from Pruitt, 1997, SDSU Cottonwood Research Station

The data indicates an underestimation of protein content by the NIRS system for forages at the Cottonwood Station. Similar analyses on energy values are being undertaken. Another part of the validation project involves monitoring actual performance of cattle versus the predicted performance of the cattle utilizing the fecal analysis and the NUTBAL software. A study involving lactating cows from the SDSU Cottonwood Research Station has shown that predicted performance is less than actual performance, suggesting an underestimation of the nutritional quality of the forage. Fecal samples were taken weekly with cow weights taken on a monthly interval. Cows were monitored beginning in early June and continuing through early December in 1996 and 1997. Results from these studies also indicate the importance of having correct calibration and prediction equations for the NIRS/NUTBAL system. Work is continuing on development of such equations for use on forages in the Upper Great Plains Region.

One aspect of the NIRS/NUTBAL system that would be useful in determining the window for supplementation is calculation of a ratio for digestible organic matter to protein content of the forage. Similar to the ratio developed by Moore et al., (1995) utilizing data from 58 dried grasses or straws, this ratio could serve as the key indicator indicating the need to or not to supplement. Moore et al., determined that increasing the ratio of digestible organic matter to crude protein to a value greater than 7 (indicating a deficiency of protein relative to energy) resulted in a negative relationship between intake and the ratio. With a ratio of less than 7 (balance between protein and digestible energy) intake was not related to the ratio. Figure 2 illustrates the ratio of digestible organic matter to crude protein as determined by NIRS fecal analysis from lactating cows in our South Dakota study for 1996.

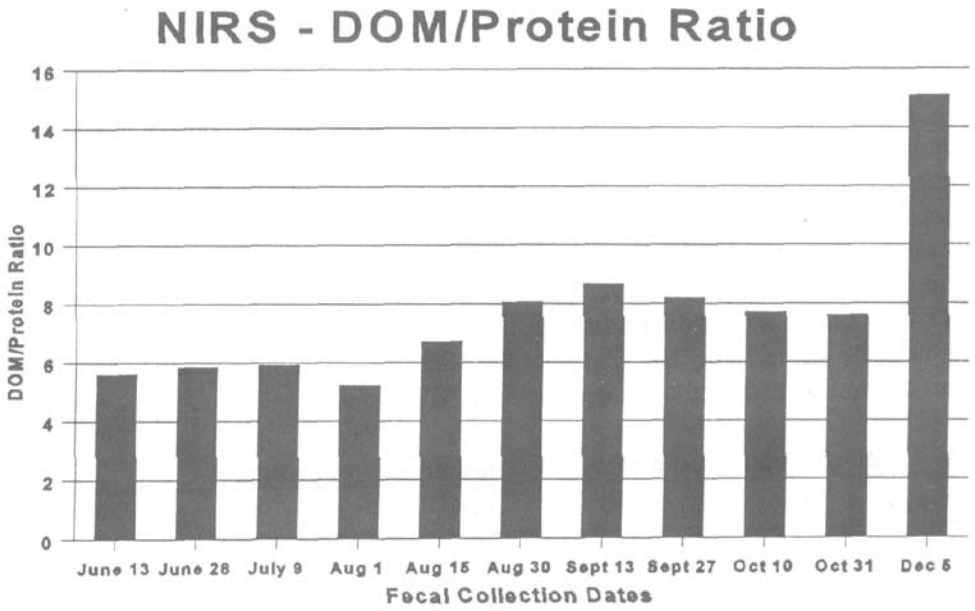

Figure 2. Ratio of Digestible Organic Matter to Crude Protein as measured by NIRS fecal analysis. Zalesky, 1996, South Dakota State University.

As the data indicates, the ratio of DOM/CP moved above seven with the August 30 sample and remained above seven for the remainder of the experimental period. The December 5 sample suggested a significant need for supplementation as the ratio exceeded 14 on that date. This data illustrates the potential use of the NIRS fecal analysis system, but again, caution at this time is warranted as it is possible that the numbers used to calculate the ratio maybe underestimating the actual forage nutrient values for protein and digestible organic matter. The system definitely has potential and work is continuing to refine the system and make it a useable technology for the Upper Great Plains Region.

PERFORMANCE GOALS

Establishment of performance goals can also aid in determining when to begin a

supplement program or when to end it. Development of desired performance should be determined by stage of production in the case of breeding females and in the case of other classes of animals the desired rate of gain. In the case of breeding females, the use of other tools such as body condition scoring can help in deciding what level of performance is needed during a specific time period for a certain stage of production. With realistic goals and a method to monitor attainment of the goals, efficient supplement programs can be developed.

SUMMARY

Answering the age old question of when to start or when to end supplementation is not always easy, especially when that decision can have a large economic impact on an operation. Development of a sound supplementation program implemented at the proper time will insure attainment of performance goals as well as insure that cost is contained to what is actually need and not more than is needed.

Currently information and technology exist to make sound decisions on when to supplement and continued efforts will see improvements in technology and information that will make that decision easier. Today, development and implementation of economically sound supplementation programs requires knowledge in the following areas:

1. Animal requirements based on stage of production and/or performance goals.

2. What the forage is providing in the way of nutrients to meet the requirements of the animal.

LITERATURE CITED

Bowman, J.G., B.F. Sowell and J.A. Patterson. 1995. Liquid supplementation for ruminants fed low-quality forage diets: a review. Anim. Feed Sci. and Tech. 55:105-138.

Cochran, R.C. 1995. Developing optimal supplementation programs for range livestock. p.58-71 In: 50 Years of Range Research Revisited. KSU Range Field Day. Oct. 27, Manhattan, KS.

McCollum, Ted. 1995. The latest methods to determine when to supplement. Proc. Range Beef Cow Symposium, p.185-189. Gering, NE.

Moore, John. 1995. Improving forage supplementation programs for beef cattle. p.81-96 In: Proc. Of Liquid Feed Symposium. Sept. 11-13. Irving, TX.

Namminga, M.C., R.J. Pruitt, C.A. Tusler and P.S. Johnson. 1992. Effects of level of concentrate and forage availability on the performance of beef cows grazing winter range. p. 9-15. South Dakota Beef Report.