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Comparison of diets collected from esophageally fistulated cows to forage quality estimated from fecal analysis

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Summary with Implications

Differences in forage quality (crude protein and energy) were analyzed between esophageally fistulated diets, analysis of fecal samples with Nutrition Balance Analyzer (NUTBAL) analysis, and analysis of hand-clipped forage samples. On upland range sites, hand-clipped samples provided forage quality estimates that were closer to esophageally fistulated diets than samples analyzed with the NUTBAL analysis. After one year of data collection, it appears that there may be some inconstancies with the NUTBAL analysis for estimates on rangeland forage quality in the Nebraska Sandhills. More data is needed to verify these results; however, making management supplementations decisions solely on the NUTBAL analysis may not always be accurate on Sandhills rangeland.

Introduction

Forage quality is difficult for beef cattle producers to measure. Researchers use fistulated animals to collect diets directly from the esophagus or rumen, but most cattlemen do not have access to fistulated animals. Hand-clipped rangeland forage samples that are analyzed at forage analysis laboratories (e.g., Ward Labs, etc.) do not always reflect the selectivity of grazing animals. The Nutrition Balance Analyzer (NUTBAL) forage quality analysis method attempts to measure forage crude protein and energy through the analysis of fecal samples collected by producers. Near Infrared Reflectance Spectroscopy (NIRS) is conducted on fecal samples and combined with client information and research/technology developed by the Grazing Animal Nutrition Lab (GAN Lab) in Temple, TX.

The objective of this study was to compare forage quality estimations from forage samples collected with fistulated grazing animals, hand-clipping, and fecal samples collected for NUTBAL analysis on Nebraska Sandhills rangelands.

Procedure

Comparisons were made between forage diets collected from esophageally fistulated cows, fecal samples from cows grazing in the same pastures, and from hand-clipped quadrats. The esophageal diets (forage the cow ate, chewed, and expelled into a collection bag when swallowed) and the hand-clipped samples were evaluated for crude protein (CP) and energy (total digestible nutrients [TDN]) by wet chemistry analysis in a commercial laboratory (Ward Labs, Kearney NE). The fecal samples were evaluated for crude protein and energy (in the form of digestible organic matter [DOM]) through the NUTBAL program utilizing NIRS. Two locations were evaluated; upland pastures (warm-season grass dominated) and subirrigated wet meadows (cool-season grass dominated) at the Gudmundsen Sandhills Lab near Whitman, NE. Hand-clipped forage samples were only collected within the upland pastures. Diet, fecal and clipped samples were collected in July, September, and November. Fecal samples were dried at 50 degree C for 72 hours prior to shipping for NUTBAL analysis.

Collections for upland pasture

Fecal samples were directly collected from 10 cows early in the months of July, September, and November of 2015. Cows were grazing upland rangeland at moderate stocking rates. Cows were in the same pasture from June to November. The cows ranged in age from 3 to 9 years old. Three esophageally fistulated cows grazed the upland pasture and diets were collected, the same time the fecal samples were collected from the cows. Forage was also clipped by hand in an effort to collect a sample representative of plants and plant parts consumed by cattle. This collection was subjective, and attempted to collect what the cows were potentially grazing.

Collections for subirrigated meadow

Fecal samples were directly collected from 10 cows early in the months of July, September, and November of 2015 grazing subirrigated meadow. Three esophageally fistulated cows grazed the meadow pasture and diets were collected, the same time the fecal samples were collected from the cows. The meadows were divided into 4 pastures. The pasture rotation allowed each pasture to be grazed twice in the growing season.

ASSUMPTIONS

Two assumptions were made: 1) the models used in the NUTBAL program represented similar forage quality and values as native Sandhills grassland in Nebraska; and 2) Fistulated animals were selecting the same diets as the grazing cows.

Other considerations included: 1) To minimize the loss of nitrogen from the manure (cow patty on the ground), fecal samples were taken directly from the cow's rectum while restrained in a cattle handling facility. 2) Total Digestible Nutrients (TDN) reported for fecal samples was calculated from the NUTBAL energy DOM. The NUTBAL DOM was converted to TDN by multiplying the DOM value reported by the GAN lab by 1.06. (NRCS Enhancement Activity 65, 2015). 3) Some nitrogen can be recycled in the saliva of the cows, therefore potentially increasing the CP estimates of the esophageally fistulated cow's diet.

STATISTICAL ANALYSIS

Data were analyzed using the Mixed Procedure in SAS with sample collection method used as the fixed effect. Differences were considered significant when $P < 0.10$ were observed.

Table 1. Crude protein (CP) and total digestible nutrient (TDN) content of diets collected from upland range by esophageally fistulated cattle compared with NUTBAL analysis of fecal samples and clipped forage

Item	Diet	NUTBAL	Clipped	SE	*P*-value
CP					
Jul	9.0[a]	7.5[b]	7.6[ab]	0.5	0.09
Sep	7.2[a]	7.4[a]	5.1[b]	0.4	< 0.01
Nov	6.0[b]	4.2[a]	5.3[ab]	0.5	0.01
TDN[1]					
Jul	60.1[b]	62.6[a]	55.8[c]	0.9	< 0.01
Sep	55.8[b]	62.0[a]	54.4[b]	1.3	< 0.01
Nov	52.9[b]	60.0[a]	47.8[b]	1.3	< 0.01

[1]Digestible organic matter reported by the Grazing Animal Nutrition Lab report was converted to TDN by multiplying DOM by 1.06.

Table 2. Crude protein (CP) and total digestible nutrient (TDN) content of diets collected from subirrigated meadows by esophageally fistulated cattle compared with NUTBAL analysis of fecal samples

Item	Diet	NUTBAL	SE	*P*-value
CP				
Jul	10.7	6.7	0.6	< 0.01
Sep	9.6	8.5	0.5	0.09
Nov	8.3	4.7	0.3	< 0.01
TDN				
Jul	58.7	61.5	0.6	< 0.01
Sep	64.0	62.4	0.7	0.09
Nov	57.8	57.7	1.6	0.99

Table 3. Actual body weight and body condition score of cows grazing upland range or meadow

Item	Jun	Jul	Sep	Nov
Upland range				
Body Weight, lbs.	954	909	968	1006
Body Condition Score	5.1	5.2	5.4	5.2
Meadow				
Body Weight, lbs.	1020	975	1022	1086
Body Condition Score	5.1	5.2	5.3	5.5

Results & Discussion

The first year (of a three year study) of data collected from esophageally fistulated steers compared to NUTBAL analyzed and hand-clipped samples resulted in significantly different measures in forage quality.

Upland Range: Crude Protein and Energy (TDN):

In July and November, diet samples contained substantially more ($P \leq 0.09$) CP than NUTBAL samples, but in September CP content of both diet and NUTBAL samples were similar ($P > 0.10$) (Table 1). In all three months TDN were inflated ($P < 0.05$) by the NUTBAL analysis. In July the NUTBAL estimate of TDN was 2.5 percentage units greater than the fistulated cow samples, but in November the value was elevated by 7.1 percentage units. A TDN estimate off by 7.1 percentage units has dramatic impact on nutritional status of an animal and would result in erroneous supplementation recommendations.

Hand-clipped samples were lower in CP and TDN than diet samples in all instances, however, the clipped samples were similar to diet samples more often than were NUTBAL estimates.

Meadows: Crude Protein and Energy (TDN):

In all three months the NUTBAL method underestimated ($P \leq 0.09$) the amount of CP in the diet (Table 2). Differences between fistulated diets and NUTBAL estimates of TDN content were not consistent. NUTBAL overestimated ($P < 0.01$) TDN in July, underestimated ($P = 0.09$) TDN in September, and was similar ($P = 0.99$) to the diet in November. No hand-clipped samples were taken on the wet meadows.

Except for upland range samples collected in the month of September, NUTBAL consistently under estimated the amount of CP being consumed by grazing cattle for both upland range and meadow. Generally, NUTBAL overestimated the amount of TDN cattle were consuming on upland range, but was not consistent in the estimate of TDN on meadow. The lack

of consistency excludes the possibility of developing an adjustment factor that can be applied to GAN lab reports to make them useful in cattle management decisions.

Reports received during this study from the GAN lab after NUTBAL analysis of fecal samples recommended feeding supplemental nutrients to prevent substantial body weight and body condition score loss. Supplemental nutrients were not fed and the animals did not lose the body weight and body condition score projected by the NUTBAL report (Table 3).

Conclusion

The NUTBAL analysis of crude protein and energy values from fecal sampling differed from a wet chemistry analysis of esophageally fistulated and hand-clipped forage samples. This raises some questions in the accuracy of this technique to correctly estimate forage quality at a given time during the year. Miscalculating available nutrients in the forage may influence supplementation strategies and either over- or under-feed cattle as a result. More research is needed to verify the accuracy of the NUTBAL analysis compared to other methods of forage quality analysis on Sandhills rangelands.

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