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PROGRESS REPORT

Influence of Grazing Management Treatments on Forage Intake, Diet Quality, Digestion Site, and Protein Flow for Forage Selected by Grazing Animals, and on Seasonal Change of Herbage Quality of Native Rangeland in Western North Dakota

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Some production costs for the beef industry in western North Dakota are unnecessarily high because the industry relies on traditional pasture management practices that inefficiently capture the nutrients produced on a land base. These practices result in higher costs for the nutrients ingested by the animals and in increased annual production costs per animal. Development of efficient pasture management strategies requires an understanding of herbage nutritional quality curves, the seasonal quality of animal-selected diets, and the seasonal digestibility of and protein supply from forage managed with different grazing treatments.

A two-year collaborative graduate-student project will evaluate the influence grazing management treatments applied during the growing season have on livestock forage intake, diet quality, digestion site, and protein flow for forage selected by grazing animals with ruminal and duodenal cannulas. Simultaneously, a second portion of the project will evaluate seasonal changes in nutritional quality of the herbage as influenced by grazing management treatments. Funding for portions of this project is provided from a Range Research Initiative.

Methods

Experiment A:

Crossbred beef steers will be fitted with indwelling ruminal and duodenal cannulas according to approved institutional animal care and use protocols. Steers will be randomly assigned to the twice-over rotation grazing treatment and the 4.5-month seasonlong grazing treatment. Samples will be taken from steer cannulas during collection periods in June, July, August, September, and, if weather permits, October during the 2000 and 2001 grazing seasons.

Each collection period will consist of 12 days. On days 1 and 2, steers will be ruminally evacuated at dawn and allowed to graze for 30 to 60 minutes. During this grazing time, total evacuated ruminal contents will be weighed and subsampled for determination of total, dry matter, and fluid fill. After the allotted grazing time, steers will be gathered, and diet masticate samples will be removed from the rumen. Samples will be stored on ice until being transported to freezer compartments for storage. On day 1, an additional sample from whole ruminal contents will be collected and stored frozen. Later, bacterial cells will be isolated from these samples and used to determine bacterial nitrogen to purine ratios. These ratios will be evaluated to determine the levels of microbial protein synthesis. This information will allow distinction between microbial and dietary origins of the duodenal protein flow. The evacuated ruminal contents remaining after all samples have been collected will be returned to the rumens of the respective steers.

Masticate samples will be transported frozen to the NDSU nutrition laboratory. All samples will be lyophilized before being analyzed for nutrient composition. A subsample from each masticate sample will be oven dried at 45C and used for the estimation of in vitro digestibility (Tilley and Terry 1963).

Twice-daily ruminal dosing of chromic oxide will begin after evacuation procedures are completed on the morning of day 2 of each collection period and will continue through day 12. Chromic oxide will be used as an indigestible flow marker in the masticated ruminal contents. It will be dosed via the rumen cannula at 0700 and 1900 hours daily for the duration of each collection period. Chromic oxide will be preweighed into #8 gelatin capsules (8+/-0.005g) and stored in a cool, dry place until dosed. Fecal grab samples will be taken at 0700, 1100, 1500, and 1900 hours on days 7 to 11. These daily samples will be composited for the 5-day sampling period for each steer during each collection period.

Duodenal sampling will also begin on day 7 and will continue through day 11. Duodenal samples will be collected at 0700, 1100, 1500, and 1900 hours daily. Approximately 250 ml of duodenal contents will be collected from each steer at each sampling time. Duodenal samples will be composited for all sampling times for each steer and collection period. Duodenal samples will be stored frozen until analyses are conducted.

On day 12, ruminal fluid will be collected from each steer via suction strainer at 0700 hours. The ruminal fluid from each steer will be placed in 12 in vitro tubes and used as inoculum for in vitro digestibility estimates. In vitro digestibility estimates will be conducted for 3 dried and ground masticate samples, 3 alpha cellulose samples, 3 blank samples, and 2 standard samples. After 48 hours of incubation, the contents of the in vitro tubes will be frozen to stop microbial fermentation and transported to the NDSU nutrition laboratory for the second stage of the in vitro digestion procedure. In vitro indigestibility and fecal output estimates will be used to estimate forage intake.

Chromium will be used as the flow marker and will be used to estimate duodenal organic matter flow. Summarized data will provide intake, chemical composition, site of digestion, degraded and undegraded intake protein supply, and microbial efficiency of grazed forage diets as influenced by season and grazing treatment.

Experiment B:

Seasonal herbage nutritional quality will be evaluated for replicated native rangeland management treatments: twice-over rotation, 4.5-month seasonlong, 6.0-month seasonlong, and long-term nongrazed treatments. Aboveground herbage samples will be collected by the standard clipping method from 2 range sites of each pasture and separated into 4 categories: cool-season grasses, warm-season grasses, sedges, and forbs. Sampling periods will be early June, late June to early July, late July to early August, late August to early September, and mid October to mid November. Five years of previously collected samples and samples collected during the 2000 and 2001 grazing seasons will be analyzed for nutritional quality. Samples will be analyzed for dry matter ash, crude protein, and acid detergent fiber (ADF) by standard procedures (AOAC 1990). Soluble and insoluble N will be determined using the 0.15 M NaCl procedure of Waldo and Goering (1970). Acid detergent insoluble N will be determined as the N remaining in the ADF residue. Mineral analyses (Ca, P, Mg, Zn, Cu, Fe, Mn, K, Na, S, Co, Mo) will be conducted by standard techniques including UV-Vis and atomic absorption spectrophotometry. Summarized data will determine the seasonal changes in nutritional quality of herbage as influenced by different grazing management treatments.

Results

Data collected for Experiment A will be reported in a graduate student thesis scheduled for completion in the spring of 2002.

Samples collected for Experiment B are being analyzed for nutritional quality. Macromineral and micromineral requirement curves for cow production periods are reported in "Mineral requirements for beef cows grazing native rangelands", located in this section.

Literature Cited

AOAC. 1990. Official Methods of Analysis (15thEd.). Association of Official Analytical Chemists. Arlington, VA.

Tilley, J.M.A., and R.A. Terry. 1963. A two-stage technique for the in vitro digestibility of forage crops. J. Br. Grassl. Soc. 18:104-111.

Waldo, D.R., and H.R. Goering. 1979. Insolubility of proteins in ruminant feeds by four methods. J. Anim. Sci. 49:1560-1568.