Calibrating Nutrient Content of Elk Diets Using Near Infra-Red Spectroscopy (NIRS) Techniques

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SUMMARY

Captive elk were fed rations of known nutritive quality to develop a predictive equation for determining crude protein (CP) and digestible organic matter (DOM) through fecal profiling. Near infra-red spectroscopy (NIRS) techniques have been developed that allow the actual nutrient level of a herbivore's diet to be estimated. Developing and validating the predictive equation for elk would allow for improved management of livestock and elk using the same seasonal rangeland.

INTRODUCTION

A technique for predicting levels of CP and digestible dry matter (DDM) in the diets of grazing animals has been developed by the Grazing Animal Nutrition Laboratory at Texas A&M University. Nutrient content is predicted by relating reflected /absorbed chemical bonds in feces to known values of CP and DDM in the ration fed to the animals. Chemical bond values are used to generate a predictive calibration set for the spectrometer.

Currently, predictive calibration data sets have been established only for free-ranging cattle and goats. However, the Dubois Sheep Experiment Station (USDA-ARS) is initiating a study to develop a predictive calibration data set for domestic sheep. The Eastern Oregon Agricultural Research Center (EOARC), Range and Wildlife Habitat Laboratory (USDA-Forest Service), National Council of the Paper Industry (NCASI), Oregon Dept. of Fish and Wildlife (Research Unit), and the Grazing Animal Nutrition Laboratory (Texas A&M University) are collaborating in developing a predictive calibration data set for Rocky Mountain Elk (*Cervus elaphus nelsonii*).

MATERIALS AND METHODS

A minimum of 30 samples, and ideally at least 50 samples, are required to create a NIRS predictive equation. In the preliminary study, 55 fecal samples were collected. Twenty-five composite fecal samples in trial number 1 were obtained from five groups of elk. They were fed 5 rations that differed by feeding level, quality, and age of animal with samples collected over 5 successive days. Thirty composite fecal samples in trial number 2 were obtained from two groups of elk fed five rations that differ by quality, with three collections at 2-day intervals.

Starkey Feed And Animals

Six adult female elk on the Starkey Experimental Area were separated into three groups of two animals each. They were fed the following: two quality levels of alfalfa hay (very high quality at 21 percent CP, and high quality at 16 percent CP); grass hay at three quality levels; and low-quality grass seed straw. All hay rations were chopped to equal-length fragments. Elk in the Starkey feeding trial were fed high-quality alfalfa hay as their normal diet. High- and medium-quality grass hay were obtained locally (Union Co.) with selection based on uniformity of species composition. Higher-quality grass hay was a mixture of timothy, bluegrass, and meadow foxtail, which are well established forage and hay species in northeast Oregon. The low-quality rations were orchard-grass hay that over-matured prior to harvest, and grass seed straw from the Willamette Valley.

Hay or pellets not consumed during each feeding trial were removed from the pen at the conclusion of each trial. All feed not consumed or used during the feeding trials was removed from the Starkey Experimental Area at the conclusion of the feeding trials. Rations were fed *ad libitum* to trial animals from feeders.

Kamela Feeds And Animals.

Elk at Kamela were fed *ad libitum* a prepared ration consisting of a known quantity and quality of alfalfa hay, and a pelleted ration mix at different intake levels. In these feeding trials, the exact amount of feed provided was known. Elk were separated into five groups consisting of three groups of mature cows, and two groups of calves.

Table 1. Kamela elk feeding regimes.

Ration Quality[a]	Feeding Level[b]	Age Class	No.
High	Ad libitum	Adults	6
High	Ad libitum	Calves	6
Medium	7% MW	Calves	12
Low	6% MW	Adults	6
Low	9% MW	Adults	6

[a]High = 14-16 % crude protein, 68% IVDDM; Medium = 12-14 % crude protein, 62% IVDDM; Low = 14-16 % crude protein, 53% IVDDM

[b]The 6% and 7% feeding levels are highly submaintenance. The 9% feeding level is roughly at maintenance, based on weight dynamics. Elk on the ad libitum diet are consuming about 11% MW.

Feeding Trials

Each feeding trial was carried out over a 15-day period. Animals in each group (both Starkey and Kamela) were allowed access to the ration for a minimum of 10 days prior to collection of fecal samples. Three fecal samples were collected following the 10-day feed adaptation period (collection on day 11, 12, 13) for a total of three samples per trial group. A composite sample consisted of an equal weight of fecal material (4-6 pellets) collected from 5 to 10 fecal deposits composited by collection day across animals in the feeding trial. Samples represented a composite of elk consumption during the previous 48 hours. Fecal sample composites were collected in a plastic "ziploc" bag, approximately 1 quart in volume, and frozen as soon as possible following collection.

RESULTS

Frozen fecal and ration samples were sent to the Grazing Animal Nutrition Laboratory, Texas A&M University, for NIRS analysis. Data analysis will be similar to analysis of data used to develop predictive equations and calibrate NIRS for cattle and goats. A "grab" sample of each hay or pellet ration is being analyzed to determine pre-ingestion levels of CP and DDM. A second grab sample obtained from orts of each ration will be analyzed for levels of CP and DDM. Differences will be used to calculate actual CP and DDM of the ingested ration. From these values, a preliminary NIRS predictive equation will be developed.

DISCUSSION

The technique is believed to be applicable to all herbivores, especially ungulate herbivores, and has potential to increase the present level of knowledge concerning a multitude of factors relating to large ungulate management. The availability of this technique presents a cheap and efficient method for: 1) determining the diet quality of free-ranging ungulates from seasonal forages; 2) determining inter-herbivore impacts on nutrient availability in multi-species grazing situations; 3) relating stocking rate to forage availability and quality; and 4) increasing levels of management possible for domestic and wild populations of grazing animals. For example, application of this technique to winter grazing livestock allows the livestock manager to quickly and efficiently keep informed of nutrients available to livestock and , in the event that nutrient levels decline below desirable levels, the manager can make the decision to provide protein and/or energy supplements to livestock.