# Predictions of the Nutrient Composition of the Diets of Supplemented Versus Unsupplemented Grazing Beef Cows Based on Near-Infrared Reflectance Spectroscopy of Feces[1]

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**ABSTRACT:** Near-infrared reflectance spectroscopy of fecal samples from crossbred beef cows grazing native range forage was performed to determine whether supplemental feeding would alter the prediction of forage quality. In one trial, 2.27 $kg \cdot cow^{-1} \cdot d^{-1}$ of supplemental feed with 20% CP and 3.3 Mcal of DE/kg had a detectible, but unimportant, effect on the predicted forage digestibility of OM, whereas the predicted forage content of CP was increased from 5.6 to 6.4% ($P < .01$). In a second trial at another location, supplemental feeding of isonitrogenous (700 $g \cdot cow^{-1} \cdot feeding^{-1}$) feeds that provided low, medium, or high levels of DE three times weekly caused detectible, but unimportant, changes in the predicted digestibility of forage OM, whereas important changes were noted in the predicted CP content of grazed forages. Although forage quality could not be evaluated from spectra developed with unsupplemented cows, a change in the plane of nutrition was detectible. In the first trial, apparent effects of supplemental feeding on predicted diet quality were not detected if fecal sampling occurred 36 or 56 h after the supplemental feeding ceased for CP and OM digestibility, respectively. Whether supplemental feeding altered the grazing behavior of cows and quality of forage grazed, or merely altered composition of fecal samples, was not determined.

Key Words: Grazing, Beef Cows, Feces, Infrared Spectroscopy, Supplementary Feeding, Nutrient Content

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## Introduction

The potential of near-infrared reflectance spectroscopy (**NIRS**) for precise and accurate quality analysis of the rangeland herbivore diet has been demonstrated with diets collected via esophageal fistula (Holechek et al., 1982; Ward et al., 1982). With proper sample processing (Lyons and Stuth, 1991), NIRS fecal monitoring of forage diet quality by NIRS of feces seems to have potential for rangeland use (Brooks et al., 1984; Coleman et al., 1989; Stuth et al., 1989) with a degree of precision approaching that of conventional diet quality analysis methods (Lyons and Stuth, 1992). Information obtained from NIRS analysis of feces could be used with computer decision support systems to aid in timely management decisions, such as supplemental feeding (Stuth et al., 1991). Beginning supplemental feeding based on NIRS of feces of animals not receiving supplemental feed seems feasible. However, adjusting or ending supplemental feeding based on the fecal analysis of animals that receive concentrates could be complicated by the effects of supplementation.

Our objective was to determine 1) whether, when using fecal NIRS equations developed from unsupplemented cows, forage quality predictions differ between supplemented and unsupplemented cows, and, if predictions differ, 2) whether sampling strategies exist, either during feeding or after termination of feeding, that would avoid such differences. Our approach was not designed to estimate diet quality of either the control or supplemented cows.

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## Materials and Methods

*Experiment 1*

Eight 6-yr-old $F_1$ Hereford × Brahman cows (average BW 527 ± 7.5 kg) were assigned randomly to either a control group (**CG**) or supplemental-feed group (**FG**). During a 22-d trial conducted in August 1989, cows in the FG were fed outdoors in 1.2-m × 2.4-m individual pens once daily at 0700 from d 1 through 17. This group was fed 2.27 $kg \cdot cow^{-1} \cdot d^{-1}$ of a range cube with 20% all-natural CP and 3.3 Mcal of DE/kg. Cows in the CG received no supplemental feed. Cows in both treatment groups grazed together on two native range pastures at the Native Plant and Animal Conservancy, approximately 3 km from College Station, TX (30° 37′ N, 96° 21′ W). Pastures were 4.2 ha each, stocked at 8.5 animal unit days per hectare, with approximately 2,000 kg/ha of herbaceous standing crop. This area is characteristic of the Texas Post Oak Savannah as described by Gould (1975) and Olson (1984), with a woody overstory, a secondary woody layer, and a herbaceous cover dominated by warm-season, perennial grasses that receive an average of 89 cm/yr of rainfall. Before this study, these pastures had not been grazed for > 1 yr.

Fecal grab samples were taken at 0700 and at 4-h intervals until dark during d 15 to 22. Days 15 to 17 were designated as the feeding period and d 17 to 22 were designated as the postfeeding period. After collection, fecal samples were stored frozen until they were processed for NIRS analysis.

Samples were dried in forced-air ovens at 60°C for 48 h, and sample moisture was stabilized before NIRS analysis (Lyons and Stuth, 1991). The NIRS spectra were stored on a microcomputer interfaced with a Pacific Scientific 4250 Scanner (NIRSystems, Perstrop Analytical, Silver Spring, MD). In vivo-corrected digestible OM (**DOM**) and CP on a DM basis were predicted with calibration equations developed from data collected from unsupplemented cows at two separate geographic locations (Lyons and Stuth, 1992).

*Data Analyses.* Data from both feeding and postfeeding periods were analyzed in split plots. Feeding period data were analyzed using animals within treatment to test whole-plot treatment effects, whereas subplot effects, which included day, sampling hour, and all interactions, were tested with the residual error term. Whole-plot treatment effects from the postfeeding period were tested using animal within treatment as the error term, whereas subplot effects, which included hours after feeding and treatment interactions, were tested using the residual error term. To determine when effects of supplemental feeding disappeared after the termination of feeding, postfeeding treatment × sampling hour effects were tested a priori using *t*-tests until treatments within two consecutive time periods were not statistically different ($P > .10$).

*Experiment 2*

Fecal samples were collected from cattle in a separate study at the H. D. Winter Experimental Ranch near Brady, TX from January through March 1989. Vegetation on the ranch is typical of a large portion of the Edwards Plateau region. Herbaceous vegetation is primarily warm-season, perennial grasses but includes several species of forbs and legumes and a few species of cool-season plants. Also, species of oak (both deciduous and evergreen) and other shrubs and trees sprinkle the landscape. Rainfall on the ranch is bimodal (spring and fall) and averages approximately 55 cm/yr. Although forage availability was not measured, visual evaluation of pastures indicated that there was ample dormant forage during the winter of 1989 (Huston and Thompson, 1990). A description of the range sites and vegetation of the study area was reported by Rector (1983).

The experimental design to study the effects of stocking rate and supplemental feeding on voluntary intake and productivity of cattle is described fully elsewhere (Huston and Thompson, 1990). Briefly, three pastures of 165, 305, and 62 ha were stocked with one animal unit (**AU**) to each 8.1, 6.1, and 4.0 ha, respectively. The AU consisted of 50% cattle (Hereford × Brangus), 25% sheep (Rambouillet), and 25% goats (Angora), with one AU defined as one cow, five sheep, or seven goats. The sheep and goats were managed the same in all pastures. Supplemental feeding treatments were imposed on the cows (individually) in each pasture between mid-December and late March for three consecutive years using a Calan Broadbent Feeding System (American Calan, Northwood, NH). Treatments included a control (no supplemental feed; **C**) and three feeds (fed three times per week) that provided equal amounts of CP and P and either low (**L**), medium (**M**), or high (**H**) levels of energy (Table 1). Feeding levels were prescribed to each cow after considering BW and condition score. The feeding levels in Table 1 apply to a 454-kg cow with a condition score of 5 on a 9-point scale. During year 2 of the 3-yr feeding study, fecal samples were collected once monthly from individual cows 2 d after feeding during January, February, and March. Samples were processed for NIRS analysis as described for Exp. 1. Data used from Exp. 2 were limited to those necessary to determine whether NIRS prediction of the nutrient composition of diets of grazing beef cattle differed between supplemented and unsupplemented cows, and, if so, whether the type of feed also influenced prediction. The purpose was not to estimate diet quality of the cows (either control or supplemented).

*Data Analyses.* Data from Exp. 2 were analyzed in a split-plot design. Because of unbalanced data, the GLM procedure (SAS, 1988) was used. Whole-plot treatment and pasture effects were tested using pasture × treatment plus animal within pasture ×

Table 1. Supplemental feed composition, feeding rate, and pasture assignments in Exp. 2

| Item | Treatment[a] C | L | M | H |
|---|---|---|---|---|
| Ingredients, % | | | | |
| Cottonseed meal | — | 93 | 44 | 7.0 |
| Grain sorghum | — | — | 52 | 89.5 |
| Molasses | — | 3 | 3 | 3.0 |
| Urea | — | 1 | — | — |
| Phosphate | — | 3 | 1 | .5 |
| Total | | 100 | 100 | 100 |
| Composition | | | | |
| CP, % | — | 42.0 | 23.8 | 12.8 |
| DE, Mcal/kg | — | 2.75 | 3.17 | 3.43 |
| Phosphorus, % | — | 1.53 | .80 | .40 |
| Mean feeding rate per period (3×/wk) | | | | |
| Supplement, kg | — | 1.7 | 2.9 | 5.5 |
| CP, g | — | 700 | 700 | 700 |
| DE, Mcal | — | 4.7 | 9.3 | 18.7 |
| Phosphorus, g | — | 28 | 26 | 24 |
| Pasture, stocking rate, ha/animal unit | | | | |
| | Animals/treatment group | | | |
| 3 (4.0) | 2 | 2 | 2 | 2 |
| 4 (8.1) | 2 | 2 | 2 | 4 |
| 5 (6.1) | 6 | 6 | 6 | 7 |

[a]Plain salt offered free-choice to all groups; C = control, no supplemental feed; L = low-energy supplement; M = medium-energy supplement; H = high-energy supplement.

treatment as a combined error term. Subplot effects including month, month × pasture, and month × treatment were tested using month × pasture × treatment plus the residual error term as a combined error term. Mean separation was accomplished with least squares means comparing the control with each feed group (PDiff option of SAS, 1988). Probabilities for these comparisons were adjusted (Ott, 1984) to control overall error rate.

Table 2. Feeding period comparisons of mean percentage of crude protein (CP) and percentage of in vivo-corrected digestible organic matter (DOM) for control (CG) and supplemental feed (FG) groups in Exp. 1

| Item | Treatment group comparison CG | FG | SE |
|---|---|---|---|
| CP | 5.6 | 6.4 | .10[a] |
| DOM | 58.0 | 58.7 | .09[a] |
| | CP | | |
| Day | | | |
| 15 | 5.9 | 6.9 | .16[b] |
| 16 | 5.4 | 5.9 | .12[b] |
| 17 | 5.4 | 6.5 | .22[b] |
| | DOM | | |
| 15 | 58.6 | 59.2 | .16[b] |
| 16 | 57.8 | 58.6 | .13[b] |
| 17 | 57.6 | 58.4 | .15[b] |

[a]n = 48/treatment.
[b]n = 16/treatment.

## Results and Discussion

### *Experiment 1*

Analysis of the whole-plot effects of the feeding period indicated that DOM predictions (Table 2) for the FG (58.7%) were only slightly greater ($P = .099$) than predictions for the CG (58%). Subplot analysis indicated that DOM predictions among days (Table 2) also differed ($P = .0001$). A treatment × day × sampling hour interaction ($P = .0892$; Figure 1) was detected. We interpret this interaction to indicate that, although feed effects were absent during some sampling periods, these periods were not predictable. Therefore, no sampling strategy to avoid feed effects on forage diet quality predictions was apparent during the time that cows were fed the supplement.

Analysis of the whole-plot treatment effects of the feeding period for CP indicated greater ($P = .007$) predictions (Table 2) for FG (6.4%) than for CG (5.6%). Subplot analysis also indicated that predictions for CP differed ($P = .0016$) among days (Table 2). A treatment × sampling hour interaction ($P = .0989$) also was detected. In addition, a treatment × day × sampling hour interaction (Figure 1) was

observed ($P$ = .0022), which we suggest provides stronger evidence that absence of feed effects was not predictable during the time that cows were fed the supplement.

During the feeding period, most DOM and CP predictions for FG were equal to or greater than CG predictions; periodic fluctuations occurred (Figure 1). Pritchard and Males (1982) observed a similar fluctuating pattern in ruminal VFA concentration with time between cattle fed wheat straw plus a protein supplement and cattle fed only wheat straw. The maximum difference between DOM predictions for FG and CG during the feeding period was 1.25 percentage units. Although statistically important ($P$ = .0892), this difference is of no practical significance because the predictions yield essentially equivalent energy values and would not result in differences in supplemental feed recommendations. Conversely, CP differences were both statistically and practically important. For example, if a 12-kg forage intake was assumed, the maximum feeding period difference in CP predictions of 2.2 percentage units would result in approximately a .26-kg greater CP intake prediction for FG than for CG. This difference could result in as much as a .64- or 1.3-kg underestimation of supplemental feed requirements compared with CG for 41 and 20% CP supplements, respectively.

The DOM data analysis for whole-plot treatment effects from the postfeeding period indicated a slight increase ($P$ = .0569) for FG (58.6%) compared with CG (57.9%). Differences ($P$ = .0001) in predictions were found among sampling hours in analysis of subplot effects. Although no ($P$ = .7875) treatment × sampling hour interaction was detected, these effects were tested a priori. Treatment × sampling hour differences were not present ($P$ > .10) 56 h after feeding (Figure 2), with a maximum difference of 1.27 percentage units between FG and CG.

Analysis of whole-plot treatment effects from the postfeeding period for CP predictions indicated no

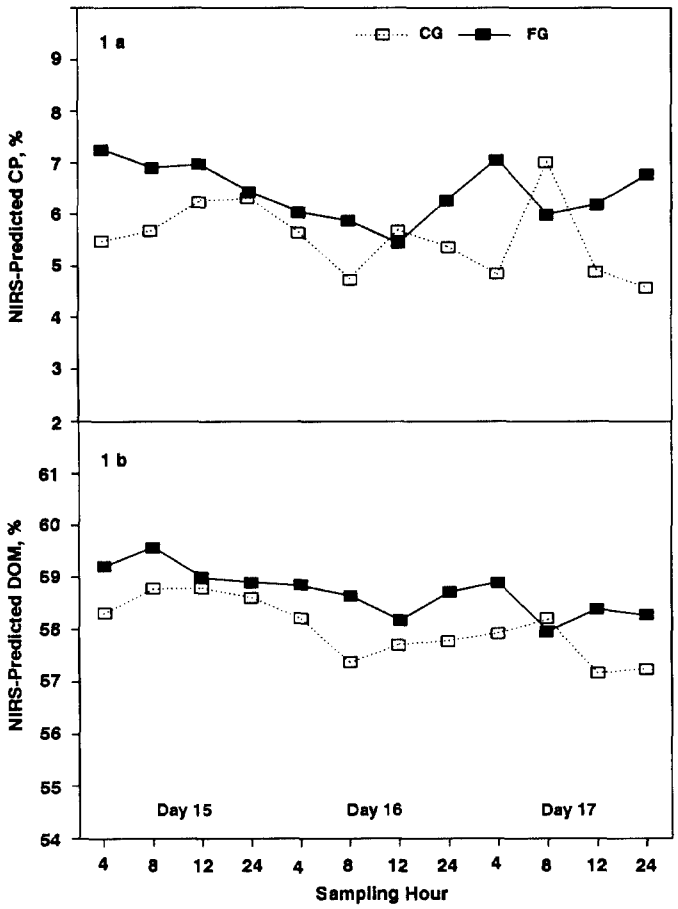


Figure 1. Comparison of predictions by near-infrared reflectance spectroscopy (NIRS) of crude protein (CP) (1a) and in vivo-corrected digestible organic matter (DOM) (1b) for fed (FG) and control (CG) groups × hours during the 3-d feeding period in Exp. 1, illustrating that there was no period during feeding in which feed effects were consistently absent.

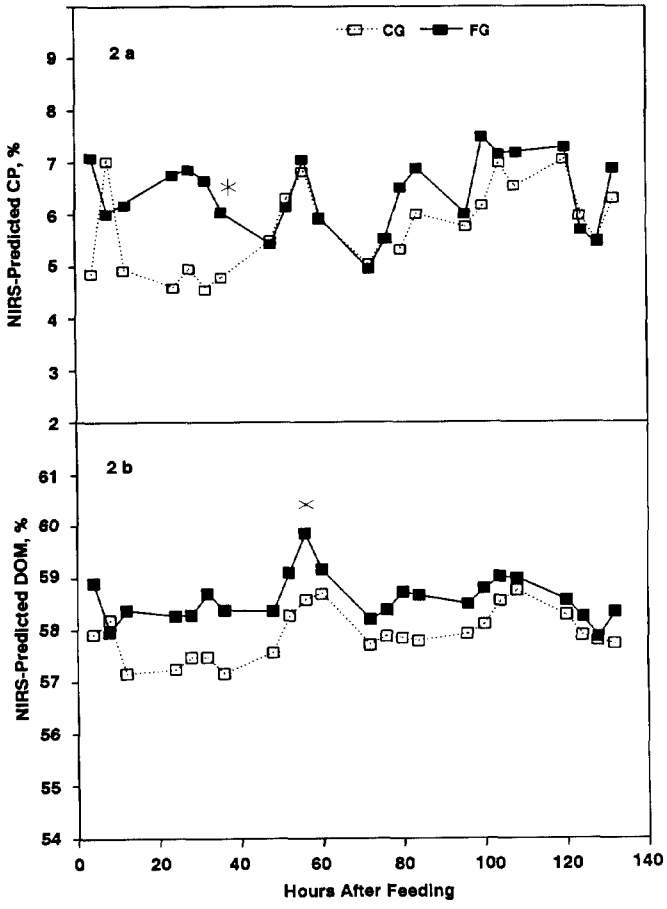


Figure 2. Predictions by near-infrared reflectance spectroscopy (NIRS) of crude protein (CP) (2a) and in vivo-corrected digestible organic matter (DOM) (2b) for fed (FG) and control (CG) groups × time after feeding for the 5-d period after the termination of feeding in Exp. 1 (* indicates time after which differences become nonsignificant [$P$ > .10]).

difference ($P$ = .1894) between the FG (6.4%) and CG (5.8%). However, in subplot analysis, a treatment × sampling hour interaction ($P$ = .0027) was observed. The a priori comparison criteria for treatment × sampling hour indicated no differences ($P$ > .10) 36 h after feeding ended (Figure 2), with a maximum difference of 2.2 percentage units between treatment groups.

The maximum DOM difference during the postfeeding interval was 1.27 percentage units, which is not important practically; however, the maximum CP difference was 2.2 percentage units, which is important practically. These results lead us to suggest a fecal sampling strategy of discontinuing supplemental feeding approximately 48 h before sampling; this strategy should avoid the effects of supplemental feed on NIRS forage quality predictions when feeding supplement on a daily basis.

*Experiment 2*

In whole-plot DOM analysis, both treatment and pasture effects were detected ($P$ = .0001). Least squares means analysis for treatment effects indicated that predictions for the C group were not different ($P$ = .2382) from those for the L group (Table 3). However, DOM predictions for M (56.0%; $P$ = .0504) and H (57.1%; $P$ = .0003) were greater than those for C (55.4%; Table 3). Analysis of subplot effects indicated significance for month ($P$ = .0105), pasture × month ($P$ = .0707), and treatment × month ($P$ = .0003). Least squares means analysis indicated that the major source of the treatment × month interaction seemed to be the lack of difference between the C and supplemental feed groups in March compared with January and February (Table 3). The maximum predicted difference between the control and supplemental feed groups was 2.3 percentage units, which occurred in January (Table 3). This difference would be of questionable practical importance.

Whole-plot effects for treatment ($P$ = .0001) and pasture ($P$ = .0004) also were present for CP predictions. Least squares means analysis for treatment effects indicated that predictions for the L (11.5%; $P$ = .0003) and M (10.6%; $P$ = .0128) groups were greater than those for the C (8.6%; Table 4) group. However, CP predictions for the H group (6.2%) were less ($P$ = .0066) than those for the C group (8.6%; Table 4). Subplot analysis indicated effects for month ($P$ = .0001), pasture × month ($P$ = .0155), and treatment × month ($P$ = .0001; Table 4). The pasture × month interaction may have resulted from differences in the botanical composition of pasture and degree of forage utilization. The treatment × month interaction may be indicative of periodic variations among treatment groups. Because samples were taken only once monthly, differences in periodic effects cannot be confirmed. Improved forage quality also may have been related to this treatment × month interaction. Sanson et al. (1990) found no adverse effects of high-energy supplement on utilization of

Table 3. Least squares means comparison of the control and treatment groups for percentage of in vivo-corrected digestible organic matter (DOM) near-infrared reflectance spectroscopy (NIRS) predictions by treatment and treatment × month for Exp. 2

| Treatment[a] | | | | | | |
|---|---|---|---|---|---|---|
| C | L | M | H | Difference | Probability | SE |
| 55.4 | 55.8 | | | -.4 | .2382 | .09[b] |
| 55.4 | | 56.0 | | -.6 | .0504 | |
| 55.4 | | | 56.7 | -1.3 | .0003 | |
| Treatment × January | | | | | | |
| 54.9 | 55.4 | | | -.5 | .1243 | .18[c] |
| 54.9 | | 55.6 | | -.7 | .0904 | |
| 54.9 | | | 57.3 | -2.3 | .0003 | |
| Treatment × February | | | | | | |
| 55.1 | 55.8 | | | -.7 | .0904 | .16[d] |
| 55.1 | | 56.4 | | -1.3 | .0006 | |
| 55.1 | | | 56.4 | -1.3 | .0003 | |
| Treatment × March | | | | | | |
| 56.2 | 56.2 | | | 0 | .9766 | .14[e] |
| 56.6 | | 56.0 | | .2 | .4275 | |
| 56.6 | | | 56.7 | -.5 | .1638 | |

[a]C = control, no supplemental feed; L = low-energy supplement; M = medium-energy supplement; H = high-energy supplement.
[b]n = 117.
[c]n = 38.
[d]n = 38.
[e]n = 41.

medium-quality hay. For the 3 mo that samples were collected, CP predictions for the L and M groups were generally greater than those for the C group (Table 4). Predictions for the H group were less than those for the C group except during March, when there was no difference (Table 4). The maximum difference between the C and supplemented groups was 5.2 percentage units for the H group in February, which is of practical significance.

Visual comparisons of near-infrared spectra in the region of equation primary wavelengths have been used to attempt to interpret the biological and chemical significance of the wavelengths (Norris et al., 1976; Barton et al., 1986; Lyons and Stuth, 1992). Lyons and Stuth (1992) suggested that the primary DOM wavelength in the predictive equation used in our study may detect microbial response to dietary energy, whereas the primary CP wavelength may detect dietary fiber residues. Because of the magnitude of difference in predictions, average spectra for treatment groups × month in Exp. 2 (Figure 3) were plotted to determine possible differences in apparent absorbance among treatment groups at the primary DOM (2,297 nm) and primary CP (2,107 nm) wavelengths. Maxima in log(1/R) spectra correspond to second-derivative minima (Barton, 1987; i.e., with second-derivative spectra, valleys indicate greater absorbance).

Visual analysis of spectra indicated slightly greater absorbance for the H group during January (Figure 3a) and February (Figure 3b) at the primary DOM equation wavelength of 2,297 nm. This finding might suggest a microbial response in the H group to available energy. Visual spectral analysis indicated less absorbance at the primary CP wavelength, 2,107 nm (Figure 3), for the L and M groups during January through March than for the C group. This result seems to indicate less dietary residue for the L and M groups, possibly as a result of increased fiber fermentation. Conversely, absorbance for the H group seemed to be greater at 2,107 nm during January (Figure 3a) and February (Figure 3b), indicating greater dietary residue, possibly as a result of decreased fiber fermentation. Decreased fiber digestion has been associated with high supplemental energy levels (Chase and Hibberd, 1987; Sanson et al., 1990), but fiber digestion was not affected by low energy levels (Krysl et al., 1989; Sanson and Clanton, 1989). Cellulolytic microbial activity could have been decreased in the H group because of fluctuations in ruminal pH resulting from the intermittent feeding pattern. Nørgaard (1987) reported a linear decrease in ruminal pH with increasing dietary energy levels. Furthermore, decreased cellulolytic enzyme activity (Smith et al., 1973) and decreased numbers of cellulolytic bacteria (Russell and Dombrowski, 1980) have been associated with pH 6.0. Hespell (1979) suggested that limitations in bacterial nutrients may uncouple bacterial growth from fermentation.

Table 4. Least squares means comparison of the control and treatment groups for percentage of crude protein near-infrared reflectance spectroscopy (NIRS) predictions by treatment and treatment × month for Exp. 2

| Treatment[a] | | | | | | |
|---|---|---|---|---|---|---|
| C | L | M | H | Difference | Probability | SE |
| 8.6 | 11.5 | | | −2.9 | .0003 | .34[b] |
| 8.6 | | 10.6 | | −2.0 | .0128 | |
| 8.6 | | | 6.2 | 2.4 | .0066 | |
| Treatment × January | | | | | | |
| 6.2 | 10.0 | | | −3.8 | .0003 | .58[c] |
| 6.2 | | 9.3 | | −3.1 | .0006 | |
| 6.2 | | | 3.0 | 3.2 | .0009 | |
| Treatment × February | | | | | | |
| 9.6 | 12.0 | | | −2.4 | .0009 | .61[d] |
| 9.6 | | 10.5 | | −.9 | .2481 | |
| 9.6 | | | 4.4 | 5.2 | .0003 | |
| Treatment × March | | | | | | |
| 9.9 | 12.6 | | | −2.7 | .0015 | .30[e] |
| 9.9 | | 12.1 | | −2.2 | .0084 | |
| 9.9 | | | 11.3 | −1.4 | .1598 | |

[a]C = control, no supplemental feed; L = low-energy supplement; M = medium-energy supplement; H = high-energy supplement.
[b]n = 117.
[c]n = 38.
[d]n = 38.
[e]n = 41.

Depending on chemical bonds being detected by NIRS, it is possible that the L and M supplements increased ruminal digestion so that fecal residues took on the character of feces from more digestible diets.

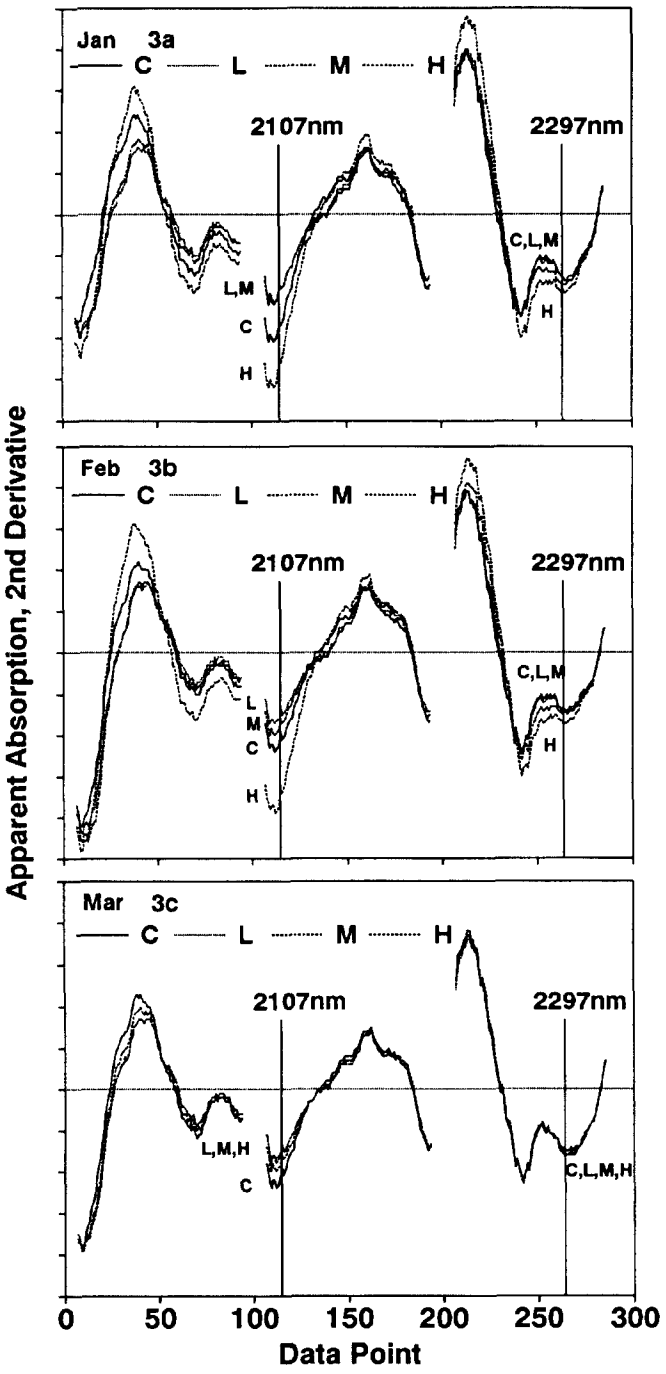


Figure 3. Comparison of second-derivative log(1/R) fecal spectra of control (C), low-energy (L), medium-energy (M), and high-energy (H) supplemental feed groups × month in Exp. 2 for the crude protein (CP) equation (2,107 nm) and in vivo-corrected digestible organic matter (DOM) equation (2,297 nm) primary wavelengths. Valleys in second-derivative spectra indicate greater absorbance; gaps indicate filter changes.

The H supplement may have decreased cellulolytic bacterial activity and resulted in escaped fiber present in the feces, making the diet seem of lower value.

Animal performance also supports suggestions of decreased fiber fermentation and microbial activity. Huston and Thompson (1990) reported less weight loss by cattle in the L group than by those in the H group and suggested altered microbial function and(or) foraging patterns as possible causes. Similarly, Sanson et al. (1990) reported greater weight loss by cows receiving an energy supplement on native range than by cows receiving protein and energy or protein supplement alone. They suggested that decreased body weight may have resulted from decreased forage intake and fiber digestibility, placing the cows in a severe negative nutrient balance. Sanson et al. (1990) reported both decreased fiber digestibility and decreased forage intakes of 5 and 17% by steers fed low-quality hay supplemented with ear corn at .26 and .52% of BW, respectively. In contrast, Freeman et al. (1992) found that for steers fed corn-based supplements at levels of .16 to .32% of BW, negative effects on fiber digestion had minimal effects on hay intake and digesta kinetics. In Exp. 2, grain sorghum was fed to the M group at .30% BW per feeding or .13% BW per day and to the H group at .99% BW per feeding or .42% BW per day. Hence, at the grain levels fed to the H group, decreased fiber utilization and(or) decreased forage intake might be expected.

Supplemental feeding may alter both the quantity and quality of forage consumed. Increased intake of low-quality forage in cattle and sheep has been associated with the feeding of supplemental protein (McCollum and Galyean, 1985; Krysl et al. 1987; Sanson et al., 1990). Conversely, decreased intake of low-quality forage has been reported in cattle fed high levels of grain (Chase and Hibberd, 1987; Sanson and Clanton, 1989; Sanson et al., 1990). Protein supplements have been associated with improved utilization of low-quality forages (Sanson et al. 1990), whereas high levels of grain have been associated with decreased digestion of these types of forage (Chase and Hibberd, 1987; Sanson and Clanton, 1989; Sanson et al., 1990).

Supplementation may also alter grazing behavior and forage selection. Hatfield et al. (1990) found differences in time spent grazing, loafing, and traveling in supplemented vs unsupplemented ewes. Hatfield (1985) reported that esophageally fistulated ewes that received supplement selected a diet greater in CP and available N than unsupplemented, esophageally fistulated ewes. It is possible that some of the differences between supplemented and unsupplemented cows detected in our study could be related to effects of supplementation on either their grazing behavior or diet selection.

Comparison of results from Exp. 1 and 2 may provide some insight into effects of supplemental feeds on fecal NIRS predictions of forage quality. First, the magnitude of differences between control and supplemental feed groups for DOM seemed to be relatively similar between the two studies (1.27 percentage units for Exp. 1 vs. 2.3 percentage units for Exp. 2); neither difference is important practically. Second, the magnitude of differences between control and treatment groups for CP seemed to be more than two times greater for Exp. 2 than for Exp. 1 (5.2 vs. 2.2 percentage units). Third, differences in CP predictions between the Exp. 2 M group and the control were as much as 1.5 times greater than the maximum difference between the group fed the supplement and the control in Exp. 1. The fact that the supplement in Exp. 1 (2.27 kg per feeding, 20% CP, 3.3 Mcal of DE/kg) and the M supplement in Exp. 2 (2.9 kg per feeding, 23% CP, 3.17 Mcal of DE/kg) were similar in composition suggests to us that the magnitude of differences in Exp. 2 may, in part, be a result of the intermittent feeding pattern (three times weekly). Further evidence that the feeding pattern may have influenced predictions is that treatment effects for CP predictions were still detected 2 d after feeding in Exp. 2 but were absent beyond 36 h after feeding in Exp. 1. Finally, energy intake (18.7 Mcal of DE per feeding for Exp. 2 H group vs 3.3 Mcal of DE per feeding for Exp. 1) seems to have affected CP predictions, possibly through decreased fiber fermentation, decreased forage intake, and(or) altered grazing behavior.

Although DOM predictions were affected by supplemental feeding in both studies, these effects do not seem to be important practically. Predictions for CP, however, were affected by supplemental feeding, both statistically and practically. For NIRS equations used in these studies, CP predictions were more sensitive to supplemental feed than were DOM predictions.

## Implications

Predictions of forage quality based on near-infrared reflectance spectroscopy of feces seemed to be affected by supplemental feeding. However, whether that effect was related to supplemental feed residues in feces, altered digestibility of forage components, and(or) altered grazing behavior was not established. Results of Exp. 1 suggest that when feeding supplements daily, feeding could be stopped for 48 h before fecal sampling to allow more accurate forage quality predictions. Results from Exp. 2 indicate that high-energy supplemental feeds and(or) intermittent feeding schedules may interfere with forage quality predictions. Additional research is needed to clarify findings in Exp. 2 and to investigate potential sampling strategies.

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