EFFECTS OF OFFERING DIFFERENT AMOUNTS AND TYPES OF SUPPLEMENTAL FEEDS TO GROWING DAIRY STEERS FED ENDOPHYTE-INFECTED FESCUE HAY AD LIBITUM ON INTAKE, DIGESTION, PASSAGE RATE AND SERUM PROLACTIN CONCENTRATION

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ABSTRACT

Ten Holstein steers (141 kg) were used in two $5 \times 5$ Latin-square experiments conducted simultaneously to determine the effects of offering different levels and types of feeds with endophyte-infected fescue given ad libitum. In Exp. 1, steers were given ad libitum access to infected fescue hay in the afternoon; in the morning fescue was given ad libitum (basal) or bermudagrass or clover hays were fed at .5 or 1.0% of body weight (BW). Supplementation did not affect total dry matter intake ($P > .10$), but supplementation at 1.0% of BW yielded total intake greater than supplementation at .5% of BW ($P < .05$). Supplementation did not change digestibilities of dry or organic matter ($P > .10$). Particulate passage rate was greater ($P < .10$) with supplementation at 1.0 than at .5% of BW, and increasing the level of supplementation from .5 to 1.0% of BW affected fluid passage rate positively with clover but negatively with bermudagrass (interaction, $P < .05$). Serum prolactin increased ($P < .05$) with all supplementation treatments, although no differences were observed between supplement type-supplementation level combinations ($P > .10$). Ground corn and wheat hay were supplements in Exp. 2. Total intake of dry matter was greater with supplements provided at 1.0 rather than at .5% of BW and for corn rather than wheat hay ($P < .05$). Neutral detergent fiber digestion (percent of intake and grams per day) rose when wheat hay was offered at 1.0 vs .5% of BW but declined when the level of supplemental corn increased from .5 to 1.0% of BW (interaction, $P < .05$). There were no differences among diets in particulate and fluid passage rates and serum prolactin concentration. Supplementation with nontoxic forage of a basal diet of infected fescue yielded intake substitution when forage was offered at .5% of BW, although incomplete substitution occurred with 1.0% of BW of supplemental forage such that total intake increased as compared to the lower level of supplementation. (Key Words: Cattle, Festuca, Intake, Digestion.)

Introduction

Tall fescue forage is an important source of nutrients for ruminants throughout the transition zone of the United States (Hemken et al., 1984). However, performance of ruminants consuming fescue is lower than expected based on concentrations of commonly measured constituents that describe forage quality (Bacon et al., 1986). Presence of an endophytic fungus (Acremonium coenophialum) and associated substances are believed responsible for poor performance (Bush et al., 1979).

Some of the changes in ruminants ingesting endophyte-infected fescue have been identified, but their contributions to low performance have not been well established. Feed intake has been shown to be depressed by presence of endophyte and accompanying toxins in fescue (Jackson et al., 1984; Kehner et al., 1985; Stokes et al., 1986). Cattle producers relying on infected fescue-based pastures for a basal nutrient source are commonly advised to dilute or substitute nontoxic feeds, often leguminous forage or grain, for consumption of infected fescue, though changes in fescue intake and digestive function that these practices elicit are unknown. Therefore, this study was conducted to determine effects of supplementing different types and levels of feeds to growing dairy steers fed endophyte-infected fescue on forage and total intake, digestion, serum prolactin concen-
tration, intake of digestible nutrients and passage rate.

**Materials and Methods**

**Exp. 1.** Five growing Holstein steers [average initial and final body weights (BW) of 130.3 and 146.6 kg, respectively] were used in a 5 x 5 Latin-square experiment with periods lasting 14 d. The trial ran from April 22 to June 30, 1986 and was in Fayetteville, Arkansas. Steers were tethered in a partially enclosed barn with free access to water. At trial initiation and on d 14 of each period, steers were weighed at 1300. Immediately thereafter blood samples were collected by jugular venipuncture, and serum was obtained by centrifugation and frozen.

Steers were given ad libitum access to endophyte-infected fescue hay (table 1) in the afternoon (1600). In the morning (0800), steers received fescue hay ad libitum (basal) or bermudagrass (BG) or clover hay (CL; table 1) at 0.5 or 1.0% of BW (0.5% BW, 1.0% BW, 0.5% CL and 1.0% CL, respectively). Levels of supplement offered were based on BW at the end of the previous period. Consumption of BG and CL was complete and orts of fescue hay were collected, quantitated and discarded before the 0800 feeding. A supplement consisting of 44.4% ground corn, 44.4% soybean meal, 5.6% dicalcium phosphate and 5.6% trace mineralized salt (>95% NaCl, 0.25% Mn, 0.2% Fe, 0.03% S, 0.033% Cu, 0.0025% Co, 0.007% I and 0.005% Zn, dry matter) was given (227 g, air-dry) at 0800 before feeding.

The first 9 d of each period were for adjustment to the diets. Hay samples were collected on d 9 to 14. On d 9 at the 1600 meal, 100 g (air-dry) of fescue hay labeled (Goetsch and Galyean, 1983) with ytterbium (Yb) and 50 ml cobalt (Co) ethylenediaminetetraacetic acid (CoEDTA; Uden et al., 1980) were mixed with 45 kg (air-dry) of fescue hay. Remaining hay was offered after consumption of the marked portion of the meal. Fecal grab samples were obtained at 0800 and 2000 on d 11, 1100 and 2300 on d 12, 1400 and 0200 on d 13 and 1700 and 0500 on d 14.

Fecal samples were dried at 55 C for 48 h, allowed to air-equilibrate at room temperature and ground through a 1-mm screen. Subsamples were taken and combined on a weight basis to form composite samples. Hay samples were ground through a 1-mm screen. Individual fecal samples were dried, combusted and ash was solubilized in acid (Ellis et al., 1982) and analyzed for Yb and Co by atomic absorption spectrophotometry. Particulate and fluid passage rates were derived by regressing the natural logarithm of marker concentration vs time post-dosing (Grovum and Williams, 1973). Composite samples of hay and feces were analyzed for dry matter (DM), ash, N (AOAC, 1975), neutral detergent fiber (NDF; Goering and Van Soest, 1970) and acid insoluble ash (AlA; Van Keulen and Young, 1977). Acid de-

### TABLE 1. COMPOSITION OF FESCUE HAYS AND SUPPLEMENTAL FEEDS FED TO GROWING DAIRY STEERS

<table>
<thead>
<tr>
<th>Item</th>
<th>Exp. 1</th>
<th>Exp. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fescue hay</td>
<td>Bermudagrass hay</td>
</tr>
<tr>
<td>Dry matter</td>
<td>93.4 (a)</td>
<td>93.6 (a)</td>
</tr>
<tr>
<td>Ash</td>
<td>6.9</td>
<td>5.6</td>
</tr>
<tr>
<td>Crude protein</td>
<td>10.5</td>
<td>14.3</td>
</tr>
<tr>
<td>Neutral detergent fiber</td>
<td>75.9</td>
<td>78.7</td>
</tr>
<tr>
<td>Acid detergent fiber</td>
<td>43.9</td>
<td>35.6</td>
</tr>
<tr>
<td>Acid detergent lignin</td>
<td>6.6</td>
<td>5.0</td>
</tr>
<tr>
<td>Cellulose</td>
<td>37.3</td>
<td>30.6</td>
</tr>
<tr>
<td>Hemicellulose</td>
<td>32.0</td>
<td>43.1</td>
</tr>
<tr>
<td>In vitro neutral detergent</td>
<td>49.6</td>
<td>52.7</td>
</tr>
<tr>
<td>fiber digestion, % of total</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*aPercentage of dry matter. 
bPercentage of air-dry matter.
tergent fiber (ADF) and lignin concentrations (ADL; Goering and Van Soest, 1970) in hay samples were determined. In vitro NDF digestibility (IVNDFD; Van Soest et al., 1966) of feed samples was determined with ruminal fluid from two ruminal-cannulated, mature Hereford cows fed medium quality bermudagrass hay for BW maintenance and given free access to trace mineralized salt. Subsamples taken from samples of hay from this experiment and from Exp. 2 were combined for analysis of loline alkaloids (Henson, 1985), one type of toxin in infected fescue (Neal and Schmidt, 1985). Serum was assayed for level of prolactin (Henson, 1985).

Intake the last 5 d of each period was not affected by day of the period (P>.10), and values were averaged for expression of DM intake and estimation of digestion. Dry matter intake in kilograms was divided by average steer BW within experimental period and multiplied by 100 to express intake as a percentage of BW. Intake of AIA and AIA concentration in feces were used to estimate fecal DM excretion. Nutrient intake, fecal DM output and concentrations of ash, N and NDF in feces were used to determine fecal excretion of organic matter (OM), N and NDF and total tract disappearance. In vitro NDF digestibility and NDF intake were used to predict NDF digestibility and intake of digested NDF for comparison to digestion in vivo.

Data were subjected to analysis of variance using the General Linear Models Procedure of the Statistical Analysis System (SAS, 1982) and considering steer, period and diet in the statistical model. Orthogonal contrasts were made to test for effects of supplementation (basal vs treatments with supplemental feeds), supplementation level (.5 vs 1.0% of BW) and supplementation type (BG vs CL) and similarity of effects of level of supplementation with the different supplement types (interaction between supplement type and supplementation level). Simple overall correlations were determined.

Exp. 2. Five growing Holstein steers (average initial and final BW of 130.5 and 155.5 kg, respectively) were used in a 5 × 5 Latin square. Procedures in this experiment were the same as those in Exp. 1, except that supplements were ground corn (CO) and wheat hay (WH; table 1). In contrast to Exp. 1, small refusals of WH occurred occasionally. Wheat hay orts were collected, quantitated and discarded before the 1600 feeding.

Results and Discussion

Exp. 1: Feed Composition. Effects of supplements on intake or digestion via correction of a ruminal N deficiency are unlikely because of the levels of crude protein in fescue hay in both experiments (table 1) and use of a corn-soybean meal supplement. Concentrations of NDF in fescue and in BG were similar and higher than in CL, and concentrations of ADL in fescue and CL were similar and higher than in BG. In vitro NDF digestion was slightly higher for BG than fescue, and both measures were greater than for CL, reflecting the high proportion of ADL in NDF of CL. Loline alkaloids can be used as an indicator of endophyte presence in fescue (Boling, 1984). Concentrations of N-acetyl and N-formyl loline alkaloids of 89.1 and 848.2 mg/kg of fescue DM, respectively, are low in comparison to other infected fescue hay samples routinely analyzed in this laboratory (unpublished data). Jackson et al. (1984) observed higher levels (643 and 972 mg/kg of N-acetyl and N-formyl loline alkaloids, respectively) in one sample of a variety of fescue selected for a low concentration of perloline and considered high in loline alkaloids. However, another sample of the same variety of fescue had a level of total loline alkaloids (875 mg/kg) similar to that in our hay.

Exp. 1: Intake. Forage supplementation decreased (P<.05) fescue intake but not total intake (P>.10; table 2), while level of supplementation changed both fescue and total intake (P<.05). Steers offered 1.0% of BW of supplemental forage consumed more DM as a percentage of BW than did steers given .5% of BW of supplemental forage. Substitution of BG or CL for fescue occurred with the low level of supplementation, but with supplementation at 1.0% of BW the decrease in fescue intake was less than the level of supplement intake.

Level of supplementation had the same effect on total intake with BG as with CL (no interaction, P>.10), even though BG and CL differ in compactability, rate of digestion and disintegration in the rumen and conduciveness to ruminal exit (Moseley and Jones, 1979; Metcalfe and Nelson, 1985; Waldo, 1986). Such supplement properties appear of little importance to total intake with low levels of supplementation because intake of infected fescue may not be limited by the amount or bulkiness of digesta in the reticulorumen. As level of
### TABLE 2. EFFECTS OF OFFERING .5 OR 1.0% BODY WEIGHT (DRY MATTER) OF BERMUDAGRASS OR CLOVER HAY TO GROWING DAIRY STEERS FED ENDOPHYTE-INFECTED FESCUE HAY AD LIBITUM ON INTAKE AND DIGESTION (EXP. 1)

<table>
<thead>
<tr>
<th>Item</th>
<th>Diet&lt;sup&gt;a&lt;/sup&gt;</th>
<th>SE&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Effect&lt;sup&gt;c&lt;/sup&gt;</th>
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<tbody>
<tr>
<td></td>
<td>Basal</td>
<td>.5% BG</td>
<td>1.0% BG</td>
</tr>
<tr>
<td>Dry matter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake, % body wt</td>
<td>2.63</td>
<td>2.64</td>
<td>2.77</td>
</tr>
<tr>
<td>Total</td>
<td>2.48</td>
<td>1.98</td>
<td>1.62</td>
</tr>
<tr>
<td>Fescue</td>
<td>.51</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Bermudagrass</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clover</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake, g/d</td>
<td>3,699</td>
<td>3,745</td>
<td>3,961</td>
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<tr>
<td>Fecal excretion, g/d</td>
<td>1,626</td>
<td>1,612</td>
<td>1,800</td>
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<tr>
<td>Total tract digestion, %</td>
<td>.56</td>
<td>.56</td>
<td>.54</td>
</tr>
<tr>
<td>Total tract digestion, g/d</td>
<td>2,073</td>
<td>2,133</td>
<td>2,161</td>
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<td>Organic matter</td>
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<td></td>
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<tr>
<td>Intake, g/d</td>
<td>3,427</td>
<td>3,483</td>
<td>3,694</td>
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<tr>
<td>Fecal excretion, g/d</td>
<td>1,474</td>
<td>1,467</td>
<td>1,637</td>
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<tr>
<td>Total tract digestion, %</td>
<td>.57</td>
<td>.57</td>
<td>.55</td>
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<tr>
<td>Total tract digestion, g/d</td>
<td>1,953</td>
<td>2,016</td>
<td>2,057</td>
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<tr>
<td>Neutral detergent fiber</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Intake, g/d</td>
<td>2,667</td>
<td>2,724</td>
<td>2,905</td>
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<td>Fecal excretion, g/d</td>
<td>1,105</td>
<td>1,079</td>
<td>1,200</td>
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<tr>
<td>Total tract digestion, %</td>
<td>.59</td>
<td>.60</td>
<td>.58</td>
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<tr>
<td>Total tract digestion, g/d</td>
<td>1,563</td>
<td>1,645</td>
<td>1,705</td>
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<td>Nitrogen</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Intake, g/d</td>
<td>69.0</td>
<td>73.1</td>
<td>80.5</td>
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<tr>
<td>Fecal excretion, g/d</td>
<td>30.7</td>
<td>32.0</td>
<td>35.0</td>
</tr>
<tr>
<td>Total tract disappearance, %</td>
<td>.54</td>
<td>.55</td>
<td>.56</td>
</tr>
<tr>
<td>Total tract disappearance, g/d</td>
<td>38.3</td>
<td>41.1</td>
<td>45.5</td>
</tr>
</tbody>
</table>

<sup>a</sup>Diet: Basal = no supplemental feed; .5% BG = bermudagrass hay supplemented at .5% body weight; 1.0% BG = bermudagrass hay supplemented at 1.0% body weight; .5% CL = clover hay supplemented at .5% body weight; 1.0% CL = clover hay supplemented at 1.0% body weight.

<sup>b</sup>SE = standard error of the diet mean based on five observations per diet.

<sup>c</sup>Effect: S = difference between the basal and other diets with offering of supplemental feeds (P<.05); s = difference between the basal and other diets with offering of supplemental feeds (P<.10); L = difference between levels of supplementation (P<.05); T = difference between supplement types (P<.05).

<sup>d</sup>Total intake is the sum of intake of fescue hay and bermudagrass or clover hay plus 207 g DM (.15% body weight) of a ground corn and soybean meal-based supplement.
supplementation increases and intake of infected fescue declines to a level at which toxicant ingestion becomes tolerable to the animal, the rate of decrease in fescue intake slows so that total intake climbs to a level that eventually will be limited by normal regulators of intake with high forage diets, most likely involving gut capacity.

*Exp. 1: Digestion.* Total tract DM and OM digestibilities were not affected (P>.10) by supplementation, but disappearance of ingested N was greater (P<.05) for diets with BG than CL (table 2). Because availability of legume N is high (Van Soest, 1982), these results may reflect absorption and recycling of N to the hindgut for support of bacterial fermentation, as indicated by a correlation of -.42 (P<.05) between fecal excretion of OM and total tract N disappearance. Digestibilities of NDF as a percentage of intake and grams per day were lower (P<.05) for CL than BG, most likely because of the high concentration of ADL in NDF of CL. Predicted total tract digestion of NDF was 49.3, 50.8, 51.2, 47.9 and 46.5% for basal, .5% BG, 1.0% BG, .5% CL and 1.0% CL diets, respectively, while predicted intake of digested NDF was 1,322, 1,390, 1,493, 1,175 and 1,211 g/d, both being considerably less than actual. In general, the difference between actual and predicted NDF digestion narrowed with increasing substitution of nontoxic feed for fescue. These results imply that effects of toxicants on ruminal microbial digestion are not major.

*Exp. 1: Passage Rates.* Particulate (fescue) passage rate was not affected (P>.10) by supplementation but was greater (P<.10) with supplementation at 1.0 than at .5% of BW (table 3). Greater intake with 1.0 than .5% of BW of supplemental forage was presumably responsible for the difference, as particulate passage rate and DM intake as a percentage of BW were correlated (r = .43; P<.03). With supplementation at 1.0% of BW, particulate passage rate increased because intake increased. Only a small change in digestion occurred with the increase in supplementation from .5 to 1.0% of BW. Hence, the quantity and proportion of particles in the rumen of a form able to pass from the rumen probably was large with the basal diet and diets with .5% of BW of supplemental forage. But with these diets the quantity of digesta in the rumen was less than to cause much distension and forced exit of acceptable particles from the rumen. Supplementation at 1.0% of BW, however, did increase intake to a level at which a transient increase in ruminal digesta volume (as compared with other diets) may have accelerated the rate of exit of particles from the rumen.

Fluid passage rate (table 3) was not affected by supplementation, supplement type or level of supplementation (P<.10), but an interaction

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**TABLE 3. EFFECTS OF OFFERING .5 OR 1.0% BODY WEIGHT (DRY MATTER) OF BERMUDAGRASS OR CLOVER HAY TO GROWING DAIRY STEERS FED ENDOPHYTE-INFECTED FESCUE HAY AD LIBITUM ON SERUM PROLACTIN CONCENTRATION AND DIGESTA PASSAGE RATE (EXP. 1)**

<table>
<thead>
<tr>
<th>Item</th>
<th>Diet</th>
<th></th>
<th></th>
<th></th>
<th>SE</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particulate (fescue) passage rate, %/h</td>
<td>Basal</td>
<td>.5% BG</td>
<td>1.0% BG</td>
<td>.5% CL</td>
<td>1.0% CL</td>
<td>.164</td>
</tr>
<tr>
<td>Fluid passage rate, %/h</td>
<td>2.81</td>
<td>2.93</td>
<td>3.26</td>
<td>2.70</td>
<td>3.05</td>
<td>.236</td>
</tr>
<tr>
<td>Serum prolactin concentration, ng/ml</td>
<td>4.1</td>
<td>12.2</td>
<td>11.9</td>
<td>11.3</td>
<td>18.6</td>
<td>3.85</td>
</tr>
</tbody>
</table>

**Effect:**  
S = difference between the basal and other diets with offering of supplemental feeds (P<.05); 1 = difference between levels of supplementation (P<.1); S = interaction between level of supplementation and supplement type (P<.05).
between the latter two was detected (P<.05). Differences in total, fescue or CL intake, the high soluble ash content of CL or CL particles more favorable for ruminal exit than particles of grass may have contributed to the greater increase in fluid passage rate with 1.0 than .5% of BW of CL. Fast passage of particles from the rumen also associates with rapid fluid exit by transporting entrained fluid. A greater increase in total intake with BG offered at 1.0 than at .5% of BW may have increased ruminal fluid volume, decreased the proportion of ruminal liquid associated with particles of a nature acceptable for ruminal exit (Owens and Goetsch, 1986), and thus slowed passage of fluid from the rumen. A similar change in fluid passage rate with the different levels of offered CL did not take place because of greater inherent digestibility of CL than BG, presumably due to less NDF in CL than BG and a tight arrangement of plant tissue types more resistant to ruminal degradation in BG (Van Soest, 1982).

Exp. 1: Prolactin. During the mid- to late-spring period in which the trial was conducted, temperature rose as the trial progressed, but did not peak. Temperature outside the building fluctuated considerably, although the building buffered temperature change somewhat. Temperature and humidity conditions did not lend to prolonged periods of heat-stress. Serum prolactin concentration was lower (P<.05) in steers fed the basal diet than in steers fed other diets (table 3). Factors such as photoperiod (Bauman et al., 1982) and temperature (Smith et al., 1977) affect prolactin level and may deter from utility as a sensitive indicator of the amount of fescue toxicants ingested or accompanying physiological stresses. Serum prolactin was not correlated with supplement or fescue intake and therefore did not appear to be such an index with the environmental conditions that the animals were subjected to in this experiment.

Exp. 2: Feed Composition. Fescue used in Exp. 2 was from the same source as in Exp. 1, nonetheless it contained less crude protein (table 1). Wheat hay was similar to fescue in NDF and ADF concentrations but contained slightly less ADL. In vitro NDF digestion of WH was considerably higher than that of fescue.

Exp. 2: Intake. Consumption of WH was slightly lower than corn intake (table 4). Providing supplemental feeds affected fescue intake as a percentage of BW (P<.05), as did level of supplementation (P<.05) and supplement type (P<.06). The decline in fescue intake was greater when supplemental WH vs CO was offered. Even though in vitro digestibility of NDF in WH was greater than of NDF in fescue, fescue intake declined more than the level of WH intake with WH given at .5% of BW. Corn given at .5% of BW decreased fescue intake by only .38% of BW, such that total DM intake tended (P>.10) to be greater than with the basal diet. The higher level of CO supplementation resulted in an additional depression in fescue intake of only .12% of BW below that incurred with the low level.

Exp. 2: Digestion. Digestion of DM and OM as percentages of intake increased (P<.05) with supplementation (table 4). Supplement type affected DM and OM digestibilities as percentages and grams per day (P<.05) due, presumably, to higher inherent digestibility of the supplements than fescue.

Supplementation, level of supplementation and supplement type affected NDF intake (P<.05), and the effect of supplement type varied with level of supplementation (interaction, P<.05; table 4). Total tract NDF digestion as a percentage of intake was greater (P<.05) for diets containing WH than CO (table 4), and the effect of supplement type on NDF digestion varied with level of supplementation (interaction, P<.05). Intake of digested NDF (table 4) was affected by supplement type, and an interaction between supplement type and level of supplementation was observed (P<.05).

Offering of supplemental feeds, level of supplementation and supplement type affected N intake, and fecal excretion of N varied with level of supplementation and supplement type (P<.05; table 4). Hence, total tract disappearances of N as a percentage of intake and grams per day were not affected by supplementation.

Predicted total tract digestion of NDF was 48.2, 49.4, 50.6, 51.2 and 55.1% for basal, .5% CO, 1.0% CO, .5% WH and 1.0% WH diets, respectively, and predicted intake of digested NDF was 1.303, 1.170, 1.144, 1.294 and 1.563 g/d. Predicted NDF digestion approximated actual digestion more closely than in Exp. 1. Predicted NDF digestion was 3 percentage units less than digestion in vivo for the .5% CO diet but 2.6 percentage units greater than actual with CO supplemented at 1.0% of BW. In relation to the difference between actual and predicted digestion for the basal diet, CO supplemented at .5% of BW had little effect on NDF digestion but caused a slight decrease
<table>
<thead>
<tr>
<th>Item</th>
<th>Diet(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Basal</td>
</tr>
<tr>
<td>Dry matter</td>
<td></td>
</tr>
<tr>
<td>Intake, % body wt</td>
<td></td>
</tr>
<tr>
<td>Total(^d)</td>
<td>2.66</td>
</tr>
<tr>
<td>Fescue</td>
<td>2.51</td>
</tr>
<tr>
<td>Corn</td>
<td>.51</td>
</tr>
<tr>
<td>Wheat hay Intake, g/d</td>
<td>3,873</td>
</tr>
<tr>
<td>Fecal excretion, g/d</td>
<td>1,924</td>
</tr>
<tr>
<td>Total tract digestion, %</td>
<td>50.9</td>
</tr>
<tr>
<td>Total tract digestion, g/d</td>
<td>1,950</td>
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<td>Organic matter</td>
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<td>Intake, g/d</td>
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<td>Fecal excretion, g/d</td>
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<td>Total tract digestion, %</td>
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<td>Total tract digestion, g/d</td>
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<td>Intake, g/d</td>
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<tr>
<td>Fecal excretion, g/d</td>
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<td>Total tract digestion, %</td>
<td>52.3</td>
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<td>Total tract digestion, g/d</td>
<td>1,402</td>
</tr>
<tr>
<td>Nitrogen</td>
<td></td>
</tr>
<tr>
<td>Intake, g/d</td>
<td>60.0</td>
</tr>
<tr>
<td>Fecal excretion, g/d</td>
<td>35.8</td>
</tr>
<tr>
<td>Total tract disappearance, %</td>
<td>40.5</td>
</tr>
<tr>
<td>Total tract disappearance, g/d</td>
<td>24.2</td>
</tr>
</tbody>
</table>

\(^a\)Diet: Basal = no supplemental feed; .5% CO = ground corn supplemented at .5% body weight; 1.0% CO = ground corn supplemented at 1.0% body weight; .5% WH = wheat hay supplemented at .5% body weight; 1.0% WH = wheat hay supplemented at 1.0% body weight.

\(^b\)SE = standard error of the diet mean based on five observations per diet.

\(^c\)Effect: S = difference between the basal and other diets with offering of supplemental feeds (P<.05); L = difference between levels of supplementation (P<.05); T = difference between supplement types (P<.05); t = difference between supplement types (P<.10). I = interaction between level of supplementation and supplement type (P<.05).

\(^d\)Total intake is the sum of intake of fescue hay and corn or wheat hay plus 207 g DM (.15% body weight) of a ground corn and soybean meal-based supplement.
when given at 1.0% of BW. Ruminal fiber digestion may be depressed by presence of readily fermentable carbohydrate when the dietary grain content is 10 or 15%, though effects become much more pronounced when the level nears 30% (Hoover, 1986). Contributions of added CO to the .5% CO and 1.0% CO diets were 18 and 32% of DM, respectively. Since corn supplementation did not affect passage rate (table 5), larger changes in NDF digestion with dietary corn addition were expected. Chase and Hibberd (1985) observed greater depressions of ruminal digestion of prairie hay acid detergent fiber with similar levels of corn supplementation.

Exp. 2: Passage Rates. Particulate and fluid passage rates (table 5) were not affected by supplementation or correlated (P>.10) with intake or digestion. In contrast, in Exp. 1 particulate passage rate was greater for the high than low level of supplementation. In the present experiment, the difference in total DM intake between WH offered at 1.0 and at .5% of BW is less than corresponding differences with BG and CL in Exp. 1. This small difference, coupled with high inherent digestibility of WH (table 1), explains the lack of difference in particulate passage rate between high and low levels of WH supplementation in Exp. 2.

Exp. 2: Prolactin. Serum prolactin concentration was not affected by supplementation, in contrast to results in Exp. 1 in which supplementation increased serum prolactin.

Total DM intake as a percentage of BW with the basal diet was similar in both experiments; however, digestion and particulate passage rate were generally higher and fluid passage rate was lower in Exp. 1 than in Exp. 2. Perhaps variation in quality of fescue hay between studies contributed to these differences. As indicated by crude protein content and IVNDFD, fescue in Exp. 2 was of slightly lower quality than fescue in Exp. 1. Lower digestion in Exp. 2 may have induced slower particulate passage rate than in Exp. 1. Ruminal NDF volume, derived by assuming that particulate passage rate was similar to the ruminal exit rate of NDF and little post-ruminal disappearance of NDF occurred, was greater in Exp. 2 than in Exp. 1. A longer lag time or a slower rate of ruminal digestion, either being the cause of lower digestion in Exp. 2, would have led to proportionately more ruminal particles in Exp. 2 than in Exp. 1 that were not of a physical nature acceptable for ruminal exit. The amount of fluid digesta associated with particles able to pass from the rumen or free-flowing and not associated with particulates may have been lowest in Exp. 2. Hence, because of positive effects of high ruminal NDF volume on saliva flow and digesta mixing, fluid in this pool was probably exposed to positions from which ruminal escape was likely more frequent in Exp. 2 than in Exp. 1.

In conclusion, changes in intake and digestion in cattle consuming endophyte-infected fescue when supplemental feeds are offered may depend on how factors that determine the mechanisms controlling intake are affected. With low levels of forage supplementation,
initial animal strategy seems to be to decrease ingestion of infected fescue by substitution of nontoxic forage without change in total intake, with maximization of energy intake being of lesser concern. After the first marked lowering of infected fescue intake, further increases in intake of supplemental forage do not elicit complete substitution for infected fescue such that total intake increases. Hence, importance appears to shift towards maximizing energy intake. Supplementation of CO depressed fescue intake less than did offering of forage, and changes in NDF digestion were not great. The decrease in fescue intake that occurred when .5% of BW of CO was given was probably not a consequence of altered rumen digestion, but may have taken place to lessen toxicant ingestion. However, since the depression in fescue intake was dissimilar to changes in Exp. 1 with forage supplementation, other modulating factors are involved. Host nutrient requirements, digestive capacity as influenced by animal type and production level, nutrient density in supplement and fescue, level of supplementation, environmental conditions and toxicity of fescue all may interact to determine how intake of infected fescue changes as the level of supplementation increases. Effects of common dietary manipulations such as offering supplemental feeds to animals fed a basal diet of toxic fescue need to be determined directly and not extrapolated from experiments with nontoxic forage. Further research should be directed towards gaining a better understanding of the mechanisms that limit intake of endophyte-infected fescue and how such drives change with dietary manipulations.

**Literature Cited**


