Digestibility of straw DM (Table 2) was similar (37.2 and 36.4 percent) for lambs supplemented with SBM and DEHY and was highest (49.2 percent) for lambs fed wheat forage. Some of the improvement in straw DM digestibility of lambs supplemented with wheat forage would be attributable to the lower wheat straw intakes.

The decreased straw consumption of lambs supplemented with wheat forage would be of concern in situations where an abundant supply of straw or other low-quality roughage was to serve as the base of the feeding program. In these situations, supplemental protein should enhance intake and utilization of the low-quality roughage. If adequate amounts of low-quality roughage were not available, the reduction in consumption of straw by wheat forage supplementation would be of less concern.

## Literature Cited

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# The Digestibility of Wheat Straw After Being Ensiled with Alfalfa or Wheat Forage

**W. A. Phillips and L. C. Pendlum**

## Story in Brief

The addition of wheat straw to wheat forage prior to ensiling increased the initial dry matter content and the amount of dry matter lost during storage. Even though the silage made of wheat forage and straw (DCS) lost more dry matter during storage, there was still more dry matter present in the silo at the time of feeding than with direct cut silage (DC). DCS silage was less digestible than DC silage. Wilting wheat forage to 43 percent dry matter before ensiling decreased dry matter digestibility (DMD). The amount of dry matter lost during ensiling and the DMD were greater for alfalfa silages than for wheat forage silages. Wilting alfalfa forage or adding wheat straw prior to ensiling decreased DMD of the silage. Wheat straw DMD was significantly decreased when added to alfalfa forage but was increased when added to wheat forage.

## Introduction

There is good probability that less grain will be fed to beef cattle in the future as a result of increased demand for corn and sorghum for other purposes and

higher prices for these grains. It will be necessary to provide increased amounts of digestible energy for beef production from forages to replace the grains presently used. The southwestern U.S. is fortunate to be able to utilize small grain forages as pasture during the fall and winter months to grow stocker calves. At the end of the wheat pasture stockering phase, perennial grass species adapted to this area are available to continue an adequate rate of gain, but as the amount of rainfall decreases during the summer months and the maturity of the species increases, daily gains will decline. In order to continue an adequate rate of gain, high quality harvested forages are necessary. These harvested forages can be employed at the beginning of the stockering season before adequate supplies of wheat forage are available or during periods of snow cover when wheat forage is unavailable. They can also be used to continue growth if the grain option is selected in March.

Harvesting available forages as a silage affords the producer the opportunity to completely mechanize the harvesting, storage and feeding system; to decrease the probability of the loss of the forage due to climatic conditions; and to store the forage in a very stable form. Some forages have too high a moisture content to be ensiled as direct cut silage at the time of cutting and must be field wilted prior to ensiling. This allows the plant to continue to respire and consume the most desirable plant components. An alternative means of increasing the dry matter content without increasing the time period from cutting to ensiling would be beneficial. The objective of this study was to determine what effect the addition of wheat straw to direct cut silage as a means of increasing the dry matter would have on dry matter digestibility and ensiling losses.

## Materials and Methods

Wheat forage in the soft dough stage of maturity and alfalfa forage at .1 bloom were harvested on separate dates and ensiled in 55-gallon containers that were lined with plastic bags. Approximately one third of the forage was ensiled immediately after harvesting and designated as direct cut silage (DC). Another third was allowed to wilt (W) before ensiling while the remaining forage was blended with chopped wheat straw before ensiling (DCS). Thus, two methods of increasing the dry matter content of the forage were used. The dry matter content of DC forage was anticipated to be approximately 30 percent. The W silage was allowed to wilt and the DCS contained enough straw to increase the dry matter content to 40 percent. Actual dry matter percentages are shown in Table 2. Wheat straw made up 21 and 22 percent of the total silage dry matter for wheat and alfalfa silages, respectively.

Twelve crossbred steers weighing 517 lb were used in six digestion trials to determine the digestibility of each of the different silages. Two digestion trials were used to establish the digestibility of the concentrate supplement fed with the silages and of the wheat straw which was used to formulate the DCS treatment. Only three silages from the same forage source were fed within a trial, and two trials were conducted for each forage source. Total dry matter consumption was limited to 1.5 percent of body weight. The silage and concentrate supplement were fed in a 2:1 ratio twice daily. The composition of supplements used for wheat and alfalfa-based silages is presented in Table 1. The digestion trials consisted of a 2-day transition, a 7-day preliminary period and a 5-day collection period. Animals were blocked according to weight, and treatments were randomly assigned for each trial with the restriction that no animal would receive the same treatment twice. Data were analyzed as a randomized block design within each trial.

**Table 1. Composition of concentrate supplements**

| Ingredients | Forage source | |
|---|---|---|
| | Wheat | Alfalfa |
| Corn | 71.0[a] | 76.2 |
| Soybean meal | 8.6 | — |
| Molasses | 14.0 | 16.9 |
| Mineral[b] | 6.4 | 6.9 |

[a]Percentage of dry matter.
[b]Minerals mix was 25% dicalcuim phosphate and 75% trace mineralized salt.

## Results and Discussion

The initial and final dry matter content of the six silages used in this study are presented in Table 2. They were determined by drying a sample of each silage at 150 F for 72 hours. The initial dry matter content of DC forages was higher than anticipated and was within an acceptable range (35-45 percent) for ensiling; thus, after wilting or having wheat straw added, the W and DCS silages were drier than planned. The dry matter percentage of the wheat forage after either wilting or adding wheat straw was 4.2 and 7 percentage units greater than DC. A more drastic shift in the dry matter percentage was noted for the alfalfa silages. Again the DC forage was drier than anticipated, and the addition of wheat straw increased the dry matter percentage by 7.3 units, similar to the DCS wheat forage. The wilted silage (W) was much drier than calculated.

**Table 2. The dry matter and crude protein content of the different silages and the amount of dry matter lost during ensiling**

| Item | Forage source | | | | | |
|---|---|---|---|---|---|---|
| | Wheat | | | Alfalfa | | |
| | DC | DCS | W | DC | DCS | W |
| Dry matter, % ;[a] | | | | | | |
| Initial | 38.7 | 45.7 | 42.9 | 34.5 | 41.8 | 51.4 |
| Final | 35.0 | 42.4 | 39.1 | 27.8 | 31.4 | 41.3 |
| Dry matter lost, %[a] | 6.8[b] | 11.6[c] | 10.3[c] | 20.3[b] | 26.0[c] | 21.1[bc] |
| Crude protein content, %[a] | 9.4 | 8.4 | 9.0 | 17.9 | 15.1 | 18.6 |

[a]Expressed as a percentage of the dry matter.
[b,c]Means in the same row and forage source with different superscripts are different ($P<.05$).

The final dry matter content was determined at the time of feeding, which was 18 months after ensiling. This was an unusually long storage period, but harvested forages used in a stocker program may be harvested one year and not fed until one to two years later, depending on the needs of the system. There was a significant decline in dry matter content during the ensiling and storage period as organic acid, water and carbon dioxide were produced by the microorganism metabolizing the plant components. Each silo was weighed at the time of ensiling and at the time of feeding. By multiplying the weight of the silage by the dry matter percentage, the amount of dry matter in the silo initially and after the 18-months storage period was determined. As anticipated, the amount of dry matter

in the silo at the time of feeding was less than at the time of ensiling. These losses are expressed as a percentage of the initial dry matter present at the time of ensiling and are presented in Table 2.

Wilting the wheat forage or adding wheat straw prior to ensiling significantly increased the amount of dry matter lost during ensiling and storage. Alfalfa forage silage lost more dry matter than wheat forage silage. The addition of wheat straw increased the amount of dry matter lost, but wilting was not significantly different from DC or DCS silage. Differences in the amount of dry matter lost are a reflection of fermentable substrates if it is assumed that the initial population of microorganisms was the same within a forage source (Edwards et al., 1978). Wilting of the forage reduced the amount of soluble carbohydrates through plant respiration while adding wheat straw diluted the soluble carbohydrate source. Crude protein content was similar among treatments and lowest for the DCS silages.

The dry matter digestibility (DMD) of the total ration of wheat straw forage plus the concentrate supplement was significantly reduced when wheat straw was added or the forage was wilted prior to ensiling (Table 3). The DMD of the concentrate supplement was determined in a separate trial using corn silage as the forage source and was used to calculate the silage DMD presented in Table 3. Wilting the wheat forage from 38.7 percent dry matter to 42.9 percent prior to ensiling decreased the DMD of the forage. It was anticipated that the addition of wheat straw would result in a lower DMD since the wheat straw used in these trials had a DMD of 48.5 percent prior to its addition to the wheat or alfalfa forage. Assuming that the wheat forage in the DCS silage was as digestible as W silage, the digestibility of the wheat straw fraction of the DCS silage was 56 percent. This was a 15.4 percent improvement in the DMD of the wheat straw as a result of being ensiled with DC wheat forage.

**Table 3. Digestibility of the total ration and the silage component**

| | | Replication | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | | | 2 | | |
| Forage | Digestibility | DC | DCS | W | DC | DCS | W |
| Wheat | Ration dry matter | 66.60[a] | 61.16[c] | 64.02[b] | 66.19[a] | 62.18[b] | 63.10[b] |
| | Silage dry matter | 69.63[a] | 60.61[b] | 65.29[ab] | 69.02[a] | 62.27[b] | 63.79[b] |
| Alfalfa | Ration dry matter | 68.78[a] | 62.66[b] | 67.07[a] | 68.01[a] | 62.8[b] | 67.05[ab] |
| | Silage dry matter | 74.92[a] | 64.60[c] | 71.85[b] | 74.13[a] | 64.26[c] | 72.34[b] |

[a,b,c]Means in the same row and replication with different superscripts are different ($P<.05$).

Wilting of alfalfa forage prior to ensiling did not significantly decrease the DMD of the ration, but the addition of wheat straw did. The DMD of the supplement fed with the alfalfa based rations was also determined in a separate trial using corn silage as the forage source. After accounting for the DMD contributed by the supplement, both W and DCS silages had a lower DMD than DC silage. The DMD of the wheat straw component of the DCS silage was calculated to be 37 percent. This was a decrease in DMD of 23 percent. The addition of wheat straw to alfalfa forage resulted in a lower DMD of the wheat straw component than when it was added to wheat forage. The combination of a highly digestible dietary component with one of low digestibility will decrease the digestibility of the latter. Given a limited amount of time for digestion of fibrous material by the rumen microorganisms, the priority by which digestion occurs is

based on susceptibility. Since alfalfa DC silage is more digestible than wheat DC silage, it is more susceptible. Thus, less time was alloted for digestion of the wheat straw.

From these data it would appear that ensiling wheat or alfalfa forage as direct cut silage at 39 and 34 percent dry matter, respectively, will result in a silage that is more digestible than when the forage is wilted prior to ensiling. The addition of wheat straw to wheat forage prior to ensiling increased the DMD of the wheat straw by 15 percent, but a decrease of 23 percent was noted when alfalfa forage was used. If silage storage space does not limit how much wheat forage is harvested as silage, then it would be advantageous to add wheat straw at the time of ensiling to increase the DMD of the wheat straw. If storage space is limited, more digestible dry matter would be realized if the straw is mixed with wheat silage at the time of feeding.

## Literature Cited

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# Calibration of a Near Infrared Reflectance Spectrometer for Prediction of Forage Quality

**S. W. Coleman, F. E. Barton, II and R. D. Meyer**

## Story in Brief

In order for near infrared (NIR) reflectance spectroscopy to be used to estimate forage quality, the instrument must first be calibrated using a set of samples of known chemical composition. Regression analysis is used to develop a relationship (calibration equations) between one or more of the wavelengths and the chemical or quality component in question. Seventy-six "Old World" Bluestem samples, collected in 1974-75, were used to calibrate the instrument. Chemical data determined near the time the samples were collected could not be used for calibration purposes after the samples had aged either because of changes in composition or erroneous laboratory determinations. Coefficients of determination were increased when the samples were reanalyzed chemically within a few weeks of the time the spectral data were collected. Those with significant differences between "actual" determination and that "predicted" by NIR were reanalyzed a third time and the new data entered into the calibration file. This procedure