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B. J. Johnson
*South Dakota State University*

P. A. Momont
*South Dakota State University*

R. J. Pruitt
*South Dakota State University*

# EFFECT OF METHIONINE, LEUCINE AND ISOVALERIC ACID ON IN VITRO DIGESTIBILITY OF CORN STOVER

B. J. Johnson[1], P. A. Momont[2] and R. J. Pruitt[3]
Department of Animal and Range Sciences

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## Summary

Two-stage in vitro fermentation was used to evaluate the amino acids methionine and leucine and a branched chain volatile fatty acid, isovaleric acid, as potential additives to a grain-urea supplement for cattle consuming corn stover. Dry matter and fiber digestibility were higher for the husks and leaves than the stalk portion of the corn plant. Providing urea as a source of nitrogen improved dry matter and fiber digestibility. There were no improvements in digestibility or fermentation rate with addition of the amino acids or volatile fatty acid evaluated.

(Key Words: Corn Stover, Urea, Methionine, Leucine, Isovaleric Acid.)

## Introduction

Enhanced digestibility, increased dry matter intake and an improvement in animal performance can be realized from providing an all natural protein supplement to cattle consuming mature, low protein forages like corn stover. Although cheaper, urea and other nonprotein nitrogen supplements are not as effective as natural proteins in improving animal performance. Recent SDSU research demonstrated the potential for improving the effectiveness of grain-urea supplements for cattle consuming mature, low protein prairie hay by adding the amino acids methionine and leucine and the branched chain volatile fatty acid isovaleric acid. This laboratory study was conducted to evaluate the potential of these compounds when urea is the major source of supplemental crude protein fed to cattle consuming corn stover.

## Materials and Methods

Corn stover was separated into the stalk component and the husks and leaves component (Table 1). Two replications of a two-stage in vitro fermentation were conducted with triplicate forage samples. Rumen fluid was obtained from two fistulated cows fed corn stover ad libitum.

TABLE 1. COMPOSITION OF CORN STOVER COMPONENTS IN IN VITRO FERMENTATIONS[a]

| Item | Stalks | Husks and leaves |
|---|---|---|
| Dry matter, % | 89.25 | 89.27 |
| Crude protein, % | 5.04 | 4.61 |
| Ash, % | 4.87 | 3.91 |
| Calcium, % | .31 | .19 |
| Phosphorus, % | .05 | .10 |
| Sulfur, % | .07 | .08 |
| ADF, % | 47.2 | 36.2 |
| NDF, % | 74.3 | 78.1 |

[a] All values except dry matter are expressed on a dry basis.

The fermentation tubes included .5 g ground forage and 25 ml buffer per tube plus one of the following additives: (1) forage alone, (2) 26.6 mg urea, (3) 26.6 mg urea and 33.3 mg starch, (4) 20 mg urea and 33.3 mg methionine, (5) 26.6 mg urea and 7.14 mg sulfur supplied by $Na_2SO_4$ (6) 20 mg urea and 29.3 mg leucine and (7) 26.6 mg urea and 22.8 mg isovaleric acid. The added amino acids supplied 25% of the supplemental nitrogen, with urea supplying the other 75%. Treatment 5 contained the same amount of sulfur as the methionine treatment. Starch added at an equal weight to methionine was used as an energy control. All other amino acids and branched chain fatty acids were isomolar to methionine. Treatments 2 through 7 were isonitrogenous. Cumulative gas

[1]Undergraduate Animal Science major.
[2]Graduate Assistant.
[3]Associate Professor.

production measured by a water displacement system was recorded at 4-hour intervals for the 48-hour incubation period. Neutral detergent fiber analysis was conducted on the second stage in vitro residues to determine fiber digestibility.

Least squares means of dry matter and neutral detergent fiber disappearance were determined by General Linear Model procedures of SAS. Nonlinear procedures of SAS were used to calculate lag phase, time to maximum fermentation and rate of fermentation (during the rapid microbial growth phase) from gas production. Further details of analysis are described in another article in this publication (CATTLE 89-8).

## Results and Discussion

Dry matter and neutral detergent fiber (NDF) disappearance were greater (P<.05) for husks and leaves than for the stalk component of the corn stover (Table 2). Although there was an interaction between treatment and stover component for both dry matter (P<.001) and NDF (P<.01) disappearance, this interaction relates primarily to a greater improvement by addition of urea for the husks and leaves than for stalks. The addition of starch, methionine, sulfur, leucine or isovaleric acid did not increase disappearance of dry matter or NDF.

The time of the lag phase and time to maximum fermentation presented in Table 3 describe the fermentation characteristics. Rate of fermentation (during the rapid microbial growth phase) is the most meaningful comparison of the treatments and stover components. There were no interactions for these variables. Husks and leaves were fermented more rapidly (P<.001) than stalks. The greater fermentation rate of the urea + starch treatment would be expected since starch is rapidly degraded. The lack of improvement in dry matter and NDF disappearance by starch addition would indicate that the improvement in fermentation rate was due to the starch itself rather than its effect on fermentation of the forage. Other additions did not increase fermentation rate over urea.

The results of this laboratory study confirm that the husk and leaf portions of corn stover are more digestible than the stalk. The potential advantages of adding methionine, leucine or isovaleric acid to a grain-urea supplement for cattle consuming corn stover are not as great as observed in previous studies with mature prairie grasses.

TABLE 2. DRY MATTER AND FIBER DISAPPEARANCE

| | Dry matter disappearance, % | | Neutral detergent fiber disappearance, % | |
|---|---|---|---|---|
| | Stalks | Husks and leaves | Stalks | Husks and leaves |
| Additives | | | | |
| Forage alone | 37.5[a] | 26.6[a] | 43.6[a] | 44.6[a] |
| Urea | 49.1[b] | 51.7[b] | 55.8[c] | 64.3[b] |
| Urea + starch | 48.9[b] | 50.3[b] | 54.7[bc] | 65.3[b] |
| Urea + methionine | 47.2[b] | 54.2[b] | 52.3[bc] | 65.7[b] |
| Urea + $Na_2SO_4$ | 46.2[b] | 51.0[b] | 52.3[bc] | 63.8[b] |
| Urea + leucine | 47.1[b] | 51.4[b] | 51.7[b] | 64.1[b] |
| Urea + isovaleric acid | 47.3[b] | 52.3[b] | 53.4[bc] | 64.8[b] |
| Standard error of means | 1.3 | 1.3 | 1.2 | 1.2 |
| Stover component | | | | |
| Overall means | 46.2[d] | 48.2[e] | 52.0[d] | 61.8[e] |
| Standard error of means | .5 | .5 | .5 | .5 |

[a,b,c] Means within a column without a common superscript differ (P<.05).
[d,e] Means within a row for the same variable without a common superscript differ (P<.05).

TABLE 3. FERMENTATION CHARACTERISTICS

| | Time of lag phase, hour | Time to maximum fermentation, hour | Rate of fermentation, ml gas/hour |
|---|---|---|---|
| Additives | | | |
| Urea | 11.0[ab] | 25.3[ab] | 1.32[b] |
| Urea + starch | 9.0[c] | 23.7[b] | 1.77[a] |
| Urea + methionine | 11.6[a] | 26.8[a] | 1.43[b] |
| Urea + $Na_2SO_4$ | 9.1[c] | 23.3[b] | 1.40[a] |
| Urea + leucine | 11.7[a] | 24.8[ab] | 1.51[b] |
| Urea + isovaleric acid | 9.8[bc] | 24.5[b] | 1.36[b] |
| Standard error of the mean | .5 | .7 | .07 |
| Stover component | | | |
| Stalks | 8.8[d] | 23.6[d] | 1.18[d] |
| Husks and leaves | 12.0[e] | 25.9[e] | 1.75[e] |
| Standard error of the mean | .3 | .4 | .04 |

[a,b,c] Means within a column without a common superscript differ ($P<.05$).
[d,e] Means within a column without a common superscript differ ($P<.01$).