# INFLUENCE OF ALFALFA ADDITION TO SOW DIETS

D. Steven Pollmann, Scott M. Dennis and Robert R. LaForge

## Summary

Twenty-four sows were utilized to evaluate the influence of a high fiber diet on nutrient digestibility and hindgut bacterial populations and volatile fatty acid (VFA) concentrations. Sows were fed either a control of milo-soybean meal or a 50% sun-cured alfalfa diet. The addition of alfalfa decreased ($P < .05$) energy, nitrogen and fiber utilization as compared to the control diet. Alfalfa-fed sows, after a 90-day adaptation, were able to utilize more cellulose and crude fiber, which contributed to slight improvement in energy utilization. Bacterial populations and VFA concentrations in the hindgut were altered when sows were fed a 50% alfalfa diet. Therefore, these results indicate that alfalfa, if cost effective, can be added to sow diets.

## Introduction

Feed represents the major cost of producing swine and about 25% of the total feed costs in a farrow-to-finish operation is attributed to maintaining the breeding herd. Thus, anything that can be done to reduce breeding herd feed costs without sacrificing production will improve the economic picture for swine producers. When conventional feeds (grain and soybean meal) are in question because of price or availability, alternate feedstuffs, such as forages, may be considered. Of all the forage crops presently grown, alfalfa appears to have the most potential as an alternative feedstuff for gestating sows.

Therefore, this study was conducted to evaluate the effect of adding alfalfa to sow diets on nutrient digestibility and hindgut bacterial populations and volatile fatty acids (VFA) concentrations.

## Experimental Procedures

Twelve sows (2nd parity) per treatment were fed isocaloric (approximately 5000 kcal of metabolizable energy per day) diets of either a control of milo-soybean meal or a 50% sun-cured alfalfa diet formulated to have similar nutrient intakes (table 1). The treated group received 2.2 pounds of sun-cured alfalfa pellets and 2.2 pounds of supplement daily and the control group received 3.7 pounds of the milo-soybean meal diet per day.

Digestion studies were conducted at 30, 60 and 90 days after the initiation of the treatments. Catheters were inserted into sows' bladders to facilitate urine collection. Fecal collections for five successive days were initiated after the appearance of ferric oxide marker in the feces. Digestibility coefficients (%) were calculated for energy, crude fiber, hemicellulose, cellulose and nitrogen. Four sows per treatment were killed at the end of each collection period and lower digestive tracts were excised for bacteria enumeration and analysis of VFA concentrations. Whole cecum and a section of the colon (approximately 3 inches anterior and posterior to apex) were ligatited and excised. Fecal samples also were collected from the distal colon and/or rectum. Concentrations of bacteria were enumerated with a complete medium and four differential carbohydrate media (starch, glucose, cellobiose, and xylan). The percentage of bacteria utilizing a specific carbohydrate was determined by comparing the counts to total count of the complete medium. Samples were taken also for VFA analyses from the cecum, colon, and feces.

## Results and Discussion

In table 2, the chemical analyses of the two diets are shown. Crude protein, ether extract (fat), calcium, and phosphorus were similar between the two diets. The crude fiber level was substantially higher for the alfalfa diet compared to the control (17.3 versus 3.1%). The fiber components (hemicellulose, cellulose, and lignin) also were greater for the alfalfa treatment.

The addition of alfalfa decreased ($P < .05$) the digestibility of nitrogen, energy, crude fiber, hemicellulose, and cellulose (table 3). Sows on the alfalfa diet had a negative nitrogen balance (-1.1 gram of nitrogen retented per day) and those on the control diet had a positive balance (9.0 grams per day). The digestibility energy value of the control was 40% greater than the alfalfa diet (1197 vs. 1681 kcal per pound). The alfalfa-fed sows, after the 90-day adaptation, were able to utilize more cellulose and crude fiber, which contributed to a slight improvement in the energy utilization.

By feeding alfalfa to sows the total VFA concentrations were not affected in the cecum and colon but were significantly increased in the feces (table 4). The total VFA concentrations were increased in the colon at day 90 for the alfalfa-fed sows. Acetic and propionic acid levels were increased in the colon and feces of sows consuming the alfalfa diet. Butyric levels in the feces were greater for sows on the alfalfa diet, but butyric levels were greater in the cecum of sows on the control diet.

Although the alfalfa addition decreased ($P < .05$) the total bacteria count (dry basis), bacteria populations (table 5) that utilize glucose, cellobiose, and xylan were increased ($P < .05$). There were no differences among locations of bacterial populations utilizing the various carbohyrate substrates. This indicates that feces could be used as an effective indicator of hindgut bacteria population in sows. The percentage of bacteria able to utilize cellulose (cellobiose) and hemicellulose (xylan) increased with time, which correlates with fiber utilization data.

Therefore, the results of this study indicate that alfalfa, if cost effective, can be added to sow diets. By feeding sows a 50% alfalfa diet, an alteration in the hindgut bacterial populations and VFA concentrations will be evident.

Table 1. Composition of Diets

| Ingredient, % | | Control | Alfalfa |
|---|---|---|---|
| Grain sorghum | | 79.8 | 41.8 |
| Alfalfa, sun-cured pellets | | -- | 50.0 |
| Soybean meal, 44% | | 15.5 | 5.5 |
| Dicalcium phosphate | | 2.5 | .7 |
| Monosodium phosphate | | -- | 1.1 |
| Limestone | | 1.1 | -- |
| Salt | | .5 | .3 |
| Vitamin premix | | .5 | .5 |
| Trace mineral premix | | .1 | .1 |
| | TOTAL | 100.0 | 100.0 |

Table 2. Analyzed Chemical Composition of Diets

| Item, % | Alfalfa | Control |
|---|---|---|
| Crude protein | 16.2 | 17.4 |
| Ether extract | 2.8 | 2.8 |
| Ash | 9.3 | 6.2 |
| Crude fiber | 17.3 | 3.1 |
| Nitrogen free extract | 35.6 | 48.7 |
| Cell well | 35.0 | 15.4 |
| Acid detergent fiber | 21.3 | 7.6 |
| Hemicellulose | 13.7 | 7.9 |
| Cellulose | 16.7 | 4.9 |
| Lignin | 5.0 | 2.5 |
| Calcium | 1.2 | 1.1 |
| Phosphorus | .8 | .9 |

Table 3. Effect of Alfalfa Addition on Nutrient Digestibility

| Item | Period, Days | | Treatment Control | Alfalfa | SE[f] |
|---|---|---|---|---|---|
| N-digestibility, %[a] | 30 | | 80.1 | 59.8 | 3.5 |
| | 60 | | 80.3 | 52.3 | |
| | 90 | | 80.5 | 53.7 | |
| | | Average | 80.3 | 55.3 | |
| Digestible energy, %[abd] | 30 | | 85.1 | 61.5 | 1.7 |
| | 60 | | 85.2 | 56.3 | |
| | 90 | | 87.4 | 63.6 | |
| | | Average | 85.9 | 60.5 | |
| Crude fiber, %[abc] | 30 | | 77.9 | 36.0 | 3.1 |
| | 60 | | 74.5 | 28.8 | |
| | 90 | | 79.8 | 41.5 | |
| | | Average | 77.4 | 35.4 | |
| Hemicellulose, %[a] | 30 | | 81.6 | 68.2 | 5.1 |
| | 60 | | 87.8 | 65.1 | |
| | 90 | | 91.7 | 74.2 | |
| | | Average | 87.0 | 69.2 | |
| Cellulose, %[abcde] | 30 | | 86.2 | 47.5 | 2.5 |
| | 60 | | 82.8 | 45.4 | |
| | 90 | | 85.8 | 60.9 | |
| | | Average | 84.9 | 51.3 | |

[a]Treatment effect ($P < .05$)

[b]Period effect ($P < .05$)

[c]Period quad ($P < .05$)

[d]Period linear ($P < .05$)

[e]Treatment by period interaction ($P < .05$)

[f]Standard error

Table 4. Effect of Alfalfa Addition on VFA Concentrations

| Item, mmoles | Period | Treatment: | Control | | | Alfalfa | | | SE |
|---|---|---|---|---|---|---|---|---|---|
| | | Location: | Cecum | Colon | Feces | Cecum | Colon | Feces | |
| Total VFA[abcd] | 30 | | 17.65 | 18.33 | 12.16 | 15.90 | 15.92 | 13.74 | .92 |
| | 60 | | 14.26 | 9.23 | 6.00 | 15.45 | 9.08 | 13.95 | |
| | 90 | | 17.41 | 13.51 | 10.26 | 14.06 | 16.17 | 14.90 | |
| | | Average | 16.44 | 13.69 | 9.47 | 15.13 | 13.37 | 14.92 | |
| Acetic[bc] | 30 | | 11.32 | 11.40 | 8.81 | 11.71 | 10.44 | 8.6 6 | 1.23 |
| | 60 | | 10.28 | 5.76 | 3.63 | 11.58 | 6.19 | 8.25 | |
| | 90 | | 12.93 | 8.55 | 6.29 | 11.34 | 10.13 | 8.87 | |
| | | Average | 11.51 | 8.57 | 6.24 | 11.54 | 8.92 | 8.59 | |
| Propionic[abcd] | 30 | | 3.92 | 3.99 | 1.98 | 2.71 | 3.22 | 3.31 | |
| | 60 | | 2.57 | 2.00 | 1.24 | 2.72 | 2.00 | 3.94 | |
| | 90 | | 3.33 | 3.14 | 2.38 | 2.17 | 3.88 | 3.99 | |
| | | Average | 3.27 | 3.04 | 1.87 | 2.53 | 3.03 | 3.75 | |
| Butyric[abcd] | 30 | | 1.74 | 2.08 | .89 | 1.03 | 1.56 | 1.27 | .16 |
| | 60 | | 1.16 | .97 | .57 | .95 | .74 | 1.05 | |
| | 90 | | 1.07 | 1.38 | .77 | .53 | 1.77 | 1.41 | |
| | | Average | 1.32 | 1.48 | .74 | .84 | 1.36 | 1.24 | |
| Minor[abd] | 30 | | .68 | .86 | .48 | .44 | .69 | .50 | .05 |
| | 60 | | .25 | .51 | .55 | .20 | .15 | .71 | |
| | 90 | | .09 | .44 | .81 | .02 | .40 | .62 | |
| | | Average | .34 | .60 | .61 | .22 | .41 | .61 | |

[a]Period effect ($P < .05$)

[b]Location effect ($P < .05$)

[c]Treatment x location interaction ($P < .05$)

[d]Period x location interaction ($P < .05$)

Table 5. Effect of Alfalfa Addition on Microbial Populations

| Item, mmoles | Period | Control | | | Alfalfa | | | SE |
|---|---|---|---|---|---|---|---|---|
| | | Cecum | Colon | Feces | Cecum | Colon | Feces | |
| Total count, $10^{6}$[abc] on dry basis | 30 | 17.2 | 38.2 | - | 2.6 | 10.0 | 23.0 | 8.6 |
| | 60 | 14.0 | 35.9 | 37.3 | 11.0 | 24.3 | 28.4 | |
| | 90 | 15.2 | 46.4 | 79.2 | 23.5 | 41.6 | 49.9 | |
| | Average | 15.5 | 40.2 | 58.3 | 12.4 | 25.3 | 33.8 | |
| Glucose, %[ad] | 30 | 68.0 | 74.7 | - | 73.0 | 83.1 | 74.6 | 4.0 |
| | 60 | 71.3 | 65.8 | 68.7 | 64.7 | 68.4 | 74.6 | |
| | 90 | 57.9 | 67.8 | 63.7 | 79.9 | 78.8 | 78.4 | |
| | Average | 65.7 | 69.5 | 66.2 | 72.5 | 76.8 | 75.9 | |
| Starch[ac] | 30 | 69.1 | 74.3 | - | 53.8 | 70.1 | 55.5 | 4.9 |
| | 60 | 75.2 | 81.2 | 78.0 | 68.9 | 71.7 | 66.4 | |
| | 90 | 74.9 | 84.6 | 85.1 | 78.8 | 78.8 | 78.5 | |
| | Average | 73.0 | 80.0 | 81.6 | 67.2 | 73.5 | 66.8 | |
| Xylan %[acd] | 30 | 42.4 | 37.9 | - | 73.1 | 57.1 | 58.2 | 4.0 |
| | 60 | 50.1 | 53.1 | 53.6 | 64.2 | 70.5 | 74.2 | |
| | 90 | 43.3 | 50.5 | 48.5 | 79.1 | 81.0 | 74.1 | |
| | Average | 45.2 | 47.1 | 51.1 | 72.1 | 69.5 | 68.8 | |
| Cellobiose[ac] | 30 | 45.7 | 40.7 | - | 76.9 | 66.4 | 67.1 | 4.4 |
| | 60 | 44.5 | 50.5 | 48.3 | 67.0 | 73.4 | 74.2 | |
| | 90 | 51.3 | 51.6 | 62.4 | 83.8 | 84.5 | 83.8 | |
| | Average | 47.2 | 47.6 | 55.4 | 75.9 | 74.8 | 75.0 | |

[a]Treatment effect ($P < .05$)

[b]Location effect ($P < .05$)

[c]Period effect ($P < .05$)

[d]Treatment by period interaction ($P < .05$)