UTILIZATION BY FINISHING PIGS OF RECONSTITUTED SORGHUM GRAIN TREATED WITH ENZYMES OR ENZYMES PLUS A BACTERIAL INOCULANT PRIOR TO ENSILING

J. I. Heidker[1] and K. C. Behnke[1]

Summary

One hundred eight finishing pigs averaging 117 lb were used to evaluate the effects of adding enzymes with or without a bacterial inoculant to reconstituted sorghum grain used in swine diets. No differences were noted in gain, feed efficiency, or carcass characteristics as determined by ultrasonic scanning.

(Key Words: Reconstituted, Grain Sorghum, Enzymes, Inoculant, Finishing Pigs.)

Introduction

Previous studies conducted at Kansas State University have shown that the solubility of the carbohydrate and protein fractions of sorghum grain is increased when an enzyme or an enzyme plus a bacterial inoculant is added to reconstituted sorghum grain prior to ensiling. These studies also have indicated that the solubilization taking place was nearing completion at the end of 7 days and little added benefit was realized if the ensiling period was increased to the more commonly accepted 21 days. However, no data are available as to the utilization of these grains by finishing swine.

The purpose of this study was to determine if the application of enzymes, a bacterial inoculant, or enzymes plus a bacterial inoculant during the reconstitution of sorghum grain prior to ensiling would improve the utilization of this grain by finishing pigs. A further objective of the study was to determine if the length of ensiling (7 vs 21 days) had an effect on subsequent utilization of the grain by pigs.

Procedures

DeKalb 41Y sorghum grain (15% moisture content), harvested from a single source, was coarsely rolled and reconstituted to approximately 26% moisture. Treatments were 1) control (no additives); 2) .0925% w/w enzyme[2] addition; and 3) .0925% w/w enzyme addition plus a bacterial inoculant; and 4) a bacterial inoculant[3]. All grain was weighed, mixed with the appropriate amount of water and treatment, packed into plastic-lined 55 gal drums using a hydraulic press, sealed, and stored in a 27°C temperature controlled room for either 7 or 21 days. Grain was prepared as necessary so that no grain was ensiled for more than 7 days past the desired opening time. Dry matter loss during ensiling was measured by weighing the grain-filled drum at the beginning and end of the ensiling period. Samples were collected from the drums for the determination of dry matter, proximate values, volatile fatty acids, lactic acid, and pH.

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[1]Department of Grain Science and Industry.

[2]Proprietary mixture supplied by Novo Laboratories, Inc., Wilton, CT.

[3]Experimental sorghum inoculant supplied by Pioneer HiBred International, Inc., Johnston, IA.

One hundred eight finishing pigs were alloted to give three pigs per treatment with two replications of each treatment in each of two barns. Because of a variation in weights and sex, one barn consisted of pens containing two barrows and one gilt per pen with an average weight of 123 lb and the second barn consisted of pens containing one barrow and two gilts with an average weight of 110 lb. Diets were randomly assigned to give two replications of each diet per barn. All diets were fed using self-feeders. Diets were formulated to contain 14.9% protein and .66% lysine (90% DM basis).

All grain to be used in the feeding study was rolled at the same time and stored until needed. Grain for the dry diet was mixed with supplement (Table 1), bagged in 50 lb paper bags, and stored until needed. Ensiled grain was mixed with supplement and stored in plastic-lined 55 gal drums until fed.

All pigs were weighed on test and every 21 days until they reached an average weight of 230 lb. The heavier group of pigs was fed for 42 days and the lighter group for 56 days. Following weighing at the end of the trial, two-thirds of the pigs in each treatment were ultrasonically scanned to determine backfat thickness and loin-eye area. Percentage of lean tissue was calculated using the formula:

Percentage of acceptable quality lean pork = [81.4 + .06 x (73% x live wt (lb) + 2.0 x loin-eye area (in^2) - 14.9 x 10th rib fat depth (in)] / 160

Results

Ensiling parameters

Dry matter loss from the grain during ensiling is given in Table 2. Losses were low for all treatments and no differences were noted between treatments. The control grain ensiled for 21 days had the highest loss, whereas the enzyme plus inoculant treated grain ensiled for 7 days had the lowest. The pH, lactic acid, acetic acid, and ethanol concentration are given in Table 3. Control grain had the highest pH for any treatment when compared to other treatments that had been ensiled for 7 or 21 days, respectively, whereas grain treated with enzymes or enzymes plus an inoculant had the lowest pH. There were no differences ($P<.05$) in pH between ensiling for 7 or 21 days except for the enzyme plus inoculant treatment, in which the grain ensiled for 21 days had a lower pH. As noted in the table, neither the lactic acid nor ethanol concentration of the ensiled grain were different, though increased lactic acid concentration did appear to result in a lower pH in the ensiled grain. All of the grains ensiled for 21 days had higher acetic acid concentrations than did grain ensiled for 7 days ($P<.05$).

Pig performance

No differences were noted in average daily gain or feed efficiency for pigs fed any of the grain treatments (Table 4). All pigs gained well, with the control grain ensiled for 7 days giving the fastest rate of gain and the dry grain giving the lowest (2.35 vs 2.01 lb/day, respectively). Feed efficiency was low for all treatments, but no differences were noted between treatments.

No differences were noted in backfat thickness, loin-eye area, or the percent of lean acceptable pork for animals fed any of the grain treatments (Table 5).

Animal performance indicates that a slight advantage would be realized by feeding ensiled grain over dry grain, but it would not appear to be economically significant based on information collected from this trial. No advantage was seen from adding enzymes or a bacterial inoculant to the ensiling grain. The length of the ensiling period did not appear to affect animal performance.

Table 1. Composition of Supplement Used in the Diets of Finishing Pigs Fed either Dry Rolled or Ensiled Reconstituted Sorghum Grain[1]

Ingredient	Percent
Soybean meal (44%)	81.00
Soy oil	3.00
Dicalcium phosphate	8.20
Limestone	3.10
Salt	1.40
Trace Mineral Mix[2]	.48
Vitamin Premix[3]	2.34
Aureomycin 50[4]	.48

[1]90% dry matter basis.
[2]Contributed the following per pound of supplement: Ca, 87 mg (minimum); Ca, 109 mg (maximum); Fe, 218 mg; Zn, 218 mg; Mn, 218 mg; Cu, 22 mg; I, 6.5 mg; Co, 2 mg.
[3]Contributed the following per pound of supplement: A, 23,400 IU; D_3, 2,340 IU; E, 94 IU; K (menadione) 9 mg; riboflavin, 23 mg; pantothenic acid, 58 mg; niacin, 129 mg; choline, 2,340 mg; B_{12}, .12 mg.
[4]A chlortetracycline calcium complex equivalent to 50g chlortetracycline HCl/lb, American Cyanamide, Princeton, NJ.

Table 2. Dry Matter Loss of Reconstituted Sorghum Grain Treated with Biological Additives and Ensiled

Treatment	Days Ensiled	Dry Matter Loss (%)
Control	7	.38
	21	.75
Enzyme	7	.26
	21	.34
Inoculant	7	.39
	21	.40
Enzyme + Inoculant	7	.16
	21	.32

Table 3. Fermentation Parameters of Reconstituted Sorghum Grain Treated with Biological Additives and Ensiled for Different Time Intervals

Treatment	Days Ensiled	pH	Lactic Acid	Acetic Acid	Ethanol
		------% of the dry matter-------			
Control	7	4.45[a]	1.17	.19[bc]	.16
	21	4.39[ab]	1.22	.22[ab]	.18
Enzyme	7	4.28[bc]	1.42	.18[bc]	.19
	21	4.16[bc]	1.53	.20[bc]	.20
Inoculant	7	4.43[ab]	1.26	.19[bc]	.18
	21	4.32[b]	1.39	.25[a]	.17
Enzyme + Inoculant	7	4.33[ab]	1.39	.18[bc]	.15
	21	4.15[c]	1.42	.17[c]	.16

[abc]Means in the same column with unlike superscripts are different (P<.05).

Table 4. Performance of Finishing Pigs Fed Dry Rolled or Ensiled Reconstituted Sorghum Grain

Treatment	Days Ensiled	Avg Starting Weight, lb	Avg Ending Weight, lb	Avg Daily Gain, lb	Feed/Gain[1]
Control	7	123	234	2.35	3.57
	21	125	242	2.09	3.49
Enzyme	7	125	236	2.03	3.53
	21	123	236	2.05	3.59
Inoculant	7	120	216	2.18	3.71
	21	122	236	2.20	3.87
Enzyme + Inoculant	7	122	234	2.04	3.46
	21	124	230	2.18	3.69
Dry rolled		120	221	2.01	4.05

[1]Dry matter basis.

Table 5. Carcass Characteristics of Finishing Pigs Fed Dry Rolled or Ensiled Reconstituted Sorghum Grain

Treatment	Days ensiled	Backfat thickness, in	Backfat 10th rib, in	Loin-eye area, in^2	Percentage Lean Pork
Control	7	.92	.70	5.70	57.88
	21	.94	.72	5.71	57.93
Enzyme	7	.93	.78	6.10	57.94
	21	.98	.78	5.66	57.36
Inoculant	7	.97	.68	5.94	58.33
	21	.98	.70	6.32	57.14
Enzyme + Inoculant	7	.82	.64	5.80	58.57
	21	.96	.82	5.80	58.76
Dry rolled		.84	.66	5.54	57.89

Swine carcasses in the new meats laboratory at K-State.