# Effects of Hemicell® Supplementation to Diets Containing Soybean Hulls on Growth Performance and Carcass Characteristics of Growing-Finishing Pigs

J.S. Park, S.D. Carter, R.W. Fent, and M.J. Rincker

## Story in Brief

A total of 96 pigs (average initial BW of 68.3 lb) were used to investigate the effects of Hemicell® addition to diets containing 10% soybean hulls on growth performance and carcass characteristics of growing-finishing pigs. Pigs were blocked by weight and randomly allotted to one of four dietary treatments. There were 6 pens/trt with 4 pigs/pen. Pigs were housed in an environmentally-controlled finishing facility, and were allowed *ad libitum* access to feed and water. Diets were formulated to .95% lysine, .70% Ca, and .60% P for Phase 1 (68.3 to126.6 lb), .80% lysine, .60% Ca, and .50% P for Phase 2 (126.6 to 184.2 lb), and .65% lysine, .55% Ca, and .50% P for Phase 3 (184.2 to 242.2 lb). All other nutrients met or exceeded NRC (1998) standards. The four treatments were: 1) corn-SBM based diet; 2) as Diet 1 + .05% Hemicell®; 3) as Diet 1 + .10% Hemicell®; and 4) as Diet 1 + .20% Hemicell®. All diets contained 10% soybean hulls, and were fed in mash form. For Phase 1, ADG, ADFI, feed/gain were not affected by Hemicell® supplementation. During Phase 2, pigs fed diets with .20% Hemicell® had the highest ADG, but there were no significant differences among treatments on growth performance or feed efficiency. For Phase 3, there were no treatment effects on ADG, ADFI, or feed/gain. Overall, adding Hemicell® did not improve growth performance. Additionally, carcass traits were not affected by Hemicell® addition. These results suggest Hemicell® addition to diets containing 10% soybean hulls did not affect growth performance or carcass traits.

Key Words: Hemicell®, Growth Performance, Carcass Characteristics

## Introduction

Beta-mannan, a non-starch polysaccharide (NSP), is a known anti-nutritional factor in broiler and swine diets. Monogastric animals lack endogenous enzymes to break down these components in the feed. Galactomannan (a chain of repeating mannose connected by β-1,4 linkage with galactose) is one NSP commonly found in soybean meal, wheat bran, and sugar beet pulp. Soybean meal (48% protein) contains about 22% NSP (Chessen, 1987), and β-mannans are found in the endosperm and hulls of the soybean.

Although reports concerning the effects of β-mannans in soybeans are limited, the guar seed has been used extensively to determine the effects of β-mannans on animal performance. Addition of guar meal or guar gum to diets decreased growth performance of broilers (Verma and McNab, 1981), increased viscosity of digesta in the rat (Blackburn and Johnson, 1981), and inhibited glucose absorption in pigs and rats (Rainbird et al.,1984; Blackburn and Johnson, 1981). Thus, dietary enzymes (e.g., cellulase and hemicellulase) have been added to diets in an attempt to improve the nutritive value of specific feedstuffs. Previous studies in our lab (Pettey et al., 1999, 2000) showed that adding Hemicell®, a beta-mannanase, to corn-SBM based diets improved growth performance and lean gain of pigs. Also, chicks fed corn-SBM based diets with

Hemicell® had higher ADG, lower feed/gain, and higher energy digestibility (McNaughton et al., 1998). Adding Hemicell® to diets containing soybeans hulls might be more beneficial due to the higher content of galactomannans in soybean hulls (Whistler and Saarnio, 1957). Therefore, the objective of this study was to determine the effects of Hemicell® supplementation on growth performance and carcass characteristics of growing-finishing pigs fed corn-SBM based diets containing 10% soybean hulls.

## Materials and Methods

A total of 96 pigs (average initial BW of 68.3 lb) were used to determine the effects of Hemicell® addition to corn-SBM-based diets containing 10% soybean hulls on growth performance and carcass characteristics of growing-finishing pigs. Pigs were blocked by weight and sex and allotted randomly to one of four dietary treatments in a randomized complete block design. There were 6 pens/trt with 4 pigs/pen. Pigs were housed in an environmentally-controlled finishing facility. Each pen had a two-hole feeder and one water nipple, and pigs were allowed *ad libitum* access to feed and water.

Diets (Table 1) were formulated to .95 % lysine, .70% Ca, and .60% P for Phase 1 (68.3 to126.6 lb), .80 % lysine, .60% Ca, and .50% P for Phase 2 (126.6 to 184.2 lb), and .65 % lysine, .55 % Ca, and .50 % P for Phase 3 (184.2 to 242.2 lb). All other nutrients met or exceeded NRC (1998) standards. The four dietary treatments were: 1) corn-SBM based diet; 2) as Diet 1 + .05% Hemicell®; 3) as Diet 1 + .10% Hemicell®; and 4) as Diet 1 + .20% Hemicell®. All diets contained 10% soybean hulls, and were fed in meal form.

**Table 1. Composition of basal diet (as-fed basis)**

| Ingredient, % | Phase 1<br>(68.3 to 126.6 lb) | Phase 2<br>(126.6 to 184.2 lb) | Phase 3<br>(184.2 to 242.2 lb) |
|---|---|---|---|
| Corn | 62.92 | 68.79 | 74.33 |
| Soybean meal | 23.92 | 18.44 | 13.00 |
| Soyhull | 10.00 | 10.00 | 10.00 |
| Dicalcium phosphate | 1.40 | .97 | 1.09 |
| Limestone | .81 | .84 | .91 |
| Sodium chloride | .25 | .25 | .50 |
| TM/Vit premix | .25 | .25 | .25 |
| Corn starch | .20 | .20 | .20 |
| Antibiotic[a] | .25 | .25 | .25 |
| Hemicell[b] | -- | -- | -- |
| | | | |
| Calculated analysis | | | |
| ME, kcal/kg | 3,128 | 3,144 | 3,149 |
| CP, % | 16.58 | 14.47 | 12.35 |
| Lysine, % | .95 | .80 | .65 |
| Ca, % | .70 | .60 | .55 |

| P, % | .60 | .50 | .50 |
|---|---|---|---|
| [a]Provided 110 mg of chlortetracycline per kg of complete diet.<br><br>[b]Hemicell® was added as 0%, .05%, .10%, and .20% of complete diets at the expense of cornstarch. | | | |

The pigs and feeders were weighed at 2-wk intervals to allow calculation of average daily gain (ADG), average feed intake (ADFI), and feed/gain (F:G). When an average block weight reached 240 lb, the pigs were killed at a commercial slaughter facility. Hot carcass weights were recorded to calculate dressing percentage. Backfat thickness was measured at the first rib, last rib and last lumbar on each half of the carcasses at the midline with a stainless steel ruler. Also, fat depth at the $10^{th}$ rib and loin muscle area were recorded to calculate the percentage of fat-free lean (FFL; NRC, 1998).

Data were analyzed as randomized complete block design using procedures described by Steel et al. (1997). The model included the effects of block (rep), treatment, and block x treatment (error). The effects of Hemicell® supplementation were partitioned into linear and curvilinear components using orthogonal polynomial contrasts. For the carcass traits, hot carcass weight was used as a covariate. In all cases, pen served as the experimental unit.

## Results and Discussion

For Phase 1 (68.3 to 126.5 lb), ADG, ADFI, feed/gain were not affected (P>.10) by enzyme supplementation (Table 2). During Phase 2 (126.6 to 184.2 lb), pigs fed diets with .20% Hemicell® had the highest gain, but there was no significant differences (P>.10) among treatments on growth performance or feed efficiency. For Phase 3 (184.2 to 242.2 lb), there were no treatment effects (P>.10) on growth performance. Overall (68.3 to 242.2 lb), Hemicell® had no effect (P>.10) on growth performance.

**Table 2. Effects of Hemicell® on growth performance of growing-finishing pigs[a]**

| Item | Hemicell® , % of diet | | | | | Probability | | |
|---|---|---|---|---|---|---|---|---|
| | 0 | .05 | .10 | .20 | SE | Linear | Quadratic | Cubic |
| Phase 1<br><br>(68.3 to 126.5 lb) | | | | | | | | |
| ADG, lb | 1.82 | 1.85 | 1.79 | 1.85 | .04 | --[b] | -- | -- |
| ADFI, lb | 4.54 | 4.76 | 4.62 | 4.63 | .10 | -- | -- | -- |
| F/G | 2.49 | 2.56 | 2.59 | 2.54 | .05 | -- | -- | -- |
| Phase 2<br><br>(126.5 to 184.2 lb) | | | | | | | | |
| ADG, lb | 1.98 | 1.92 | 1.99 | 2.04 | .06 | -- | -- | -- |
| ADFI, lb | 6.48 | 6.84 | 6.75 | 6.80 | .25 | -- | -- | -- |
| F/G | 3.30 | 3.57 | 3.39 | 3.31 | .04 | -- | -- | -- |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Phase 3 (184.2 to 242.2 lb) | | | | | | | | |
| ADG, lb | 1.74 | 1.79 | 1.69 | 1.69 | .07 | -- | -- | -- |
| ADFI, lb | 6.42 | 6.90 | 6.37 | 6.64 | .27 | -- | -- | -- |
| F/G | 3.82 | 3.85 | 3.76 | 3.92 | .21 | -- | -- | -- |
| Overall (68.3 to 242.2 lb) | | | | | | | | |
| ADG, lb | 1.89 | 1.88 | 1.85 | 1.86 | .03 | -- | -- | -- |
| ADFI, lb | 5.76 | 6.08 | 6.01 | 6.01 | .12 | -- | -- | -- |
| F/G | 3.07 | 3.23 | 3.25 | 3.23 | .08 | -- | -- | -- |

[a]Least squares means for 6 pens/treatment of 4 pigs/pen.

[b]Dashes indicate P>.10.

Dressing percentage, backfat thickness, loin muscle area, and fat-free lean (%) were not improved (P>.10) by enzyme supplementation (Table 3). These results are in contrast with previous studies in our lab. Pettey et al. (1999) reported that supplementation of Hemicell® increased ADG of growing-finishing pigs fed corn-SBM based diets. Also, Pettey et al. (2000) reported that pigs fed corn-SBM based diets with .05% Hemicell® had higher lean gain. In broilers, McNaughton et al. (1998) reported that chicks fed corn-SBM based diets with Hemicell® had higher ADG, lower feed/gain, and higher energy digestibility. These previous studies suggest that adding .05% Hemicell® to corn-SBM-based diets improves growth and feed efficiency of nursery and growing-finishing pigs fed corn-SBM based diets. However, in this study, higher levels of Hemicell® supplementation (.05 to .20%) did not improve growth performance. Unlike previous studies, diets in this study contained 10% soybean hulls, which may have affected the response to Hemicell® addition.

**Table 3. Effects of Hemicell® on carcass characteristic of growing-finishing pigs[ab]**

| Item | Hemicell®, % of diet | | | | | Probability | | |
|---|---|---|---|---|---|---|---|---|
| | 0 | .05 | .10 | .20 | SE | Linear | Quadratic | Cubic |
| HCW, lb | 183.4 | 184.2 | 179.6 | 184.1 | 2.6 | --[c] | -- | -- |
| DP, % | 75.3 | 75.8 | 75.1 | 76.1 | .40 | -- | -- | -- |
| Avg. BF, in | 1.07 | 1.08 | 1.03 | 1.08 | .02 | -- | -- | -- |
| 10th fat depth, in | .83 | .81 | .77 | .80 | .03 | -- | -- | -- |
| LMA, $in^2$ | 6.82 | 6.81 | 6.95 | 6.87 | .13 | -- | -- | -- |
| FFL, % | 50.94 | 51.19 | 51.86 | 51.23 | .44 | -- | -- | -- |

[a]Least squares means for 6 pens/treatment of 4 pigs/pen.

[b]HCW was used as covariate for BF, LMA, and FFL.

[c]Dashes indicate P>.10.

## Implications

In previous research, Hemicell® supplementation consistently improved growth performance of nursery and growing-finishing pigs fed corn-SBM-based diets. However, in this study, Hemicell® addition did not affect growth performance or carcass characteristics of growing-finishing pigs fed corn-SBM diets containing 10% soybean hulls. This discrepancy in results is most likely due to the inclusion of soybean hulls in the diets, which significantly increased the substrate:enzyme ratio as compared to that of typical corn-SBM diet. Thus, the highest level of Hemicell® used in this study (.20%) may not have been great enough to hydrolyze the increased substrate (β-mannan) level in diets containing soybean hulls. Additional research is necessary to determine the optimum levels of Hemicell® for use in corn-SBM based diets containing 10% soybean hulls.

## Literature Cited


Blackburn, N.A. and I.T. Johnson. 1981. Br. J. Nutr. 46:239.

Chessen, A. 1987. Recent Advances in Animal Nutrition. Haresign, W. and D.J.A. Cole p 71. Butterworths, Boston, MA.

McNaughton, J.L. et al. 1998. Poultry Sci. 77 (Suppl 1):153.

NRC. 1998. Nutrient Requirements of Swine. 10th ed. National Academy Press, Washington, DC.

Pettey, L.A. et al. 1999. Okla. Agr. Exp. Sta. Res. Rep. P-973-273.

Pettey, L.A. et al. 2000. J. Anim. Sci. 78(Suppl. 2):214.

Rainbird, A.L. et al. 1984. Br. J. Nutr. 52:489.

Steel, R.D.G. et al. 1997. Principle and Procedures of Statistics: A Biometrical Approach. 3rd ed. McGraw-Hill Publishing Co., New York.

Verma, S.V.S. and J.M. McNab. 1981. Br. Poultry Sci. 23:95.

Whistler, R.L and J. Saarnio. 1957. J. Am. Chem. Soc. 79:6055.




---