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EFFECTS OF HEMICELL® ADDITION TO NURSERY DIETS ON GROWTH PERFORMANCE OF WEANLING PIGS

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Story in Brief

Two experiments were conducted to evaluate the effects of Hemicell® [5] addition to nursery diets on growth performance of weanling pigs. In Experiment 1, 156 weanling pigs (13.8 lb) were allotted randomly based on weight, sex and genotype to four dietary treatments. Dietary treatments were: 1) a fortified corn-soybean meal diet containing spray-dried plasma and blood meal (complex), 2) a corn-soybean meal diet (simple), 3) the complex diet with Hemicell® (.05%), and 4) the simple diet with Hemicell® (.05%). Pigs were fed in three dietary phases over a 42-d period. All diets were formulated to contain 1.50, 1.30, and 1.10% lysine for Phases 1 (d 0-14), 2 (d 14-28), and 3 (d 28-42), respectively. For Phases 1 and 2, pigs fed the complex diets gained faster and were more efficient than pigs fed simple diets. During Phase 3, pigs fed simple diets with Hemicell® had improved feed:gain ratios compared with pigs fed diets with no added Hemicell® . Overall, pigs fed complex diets or diets with Hemicell® grew faster and were more efficient than pigs fed simple corn-SBM diets. In Experiment 2, 117 weanling pigs (30 lb) were randomly assigned to three dietary treatments. Treatments were: 1) a fortified corn-SBM diet serving as the control, 2) the control diet with soybean oil added to increase metabolizable energy (ME), and 3) the control diet with Hemicell® (.05%). Over the entire 3-wk period, pigs fed the diet with added Hemicell® more efficiently converted feed to gain compared with pigs fed the control diet, and gained similarly to pigs fed the diet with added soybean oil. Both experiments suggest increased growth performance and improved efficiency of gain for pigs fed diets with added Hemicell® during the late nursery phase.

Key Words: Enzyme, Weanling Pigs, Growth Performance

Introduction

Many non-starch polysaccharides (NSP), other than cellulose, are known to be present in the structure of plant cell walls. These components, generally known as hemicelluloses, are prevalent in the ungerminated seeds of many feedstuffs commonly used in swine diets. These leguminous seeds, including soybean meal, can contain up to 22.7% non-starch polysaccharides on a dry matter basis (Chesson, 1987). Galactomannan, a hemicellulose, is chemically composed of a d-mannose backbone with d-galactose units attached. Having a similar structure, galactomannans can have the same physiological effects as guar gum. Many anti-nutritional aspects of guar gums have been determined in broilers and growing swine. Rainbird and Low (1986) found that diets with added guar gum fed to growing pigs increased viscosity of stomach digesta leading to decreased absorption in the small intestine. Monogastrics, including pigs, lack the proper enzyme to break down galactomannans. Beta-d-mannanase degrades galactomannans and is commercially available as a patented feed additive, Hemicell® . Unpublished research has shown that Hemicell® , when added to broiler diets, decreased feed:gain ratios and improved the energy availability in low quality feeds. The objectives of these studies were: 1) to determine what effects, if any, Hemicell® had on growth performance of weanling pigs fed complex or simple diets, and 2) whether pigs fed diets with added Hemicell® performed similarly to pigs fed diets with an added fat source.

Materials and Methods

Experiment 1. One hundred fifty-six pigs were weaned and allotted randomly by weight, genotype and sex to four dietary treatments. The experimental design was a 2 x 2 factorial arrangement of treatments with six pen replicates per treatment. Yorkshires, Hampshires, and Hampshire x Yorkshire crosses were used and equally distributed across treatments. Pigs were penned with 6 to 7 pigs per pen in a temperature controlled room with all feed and water offered ad libitum. Pigs were fed in three dietary phases. Phase 1 (d 0 to 7) and Phase 2 (d 7 to 21) included complex and simple diets. Complex diets were fortified corn-SBM based with spray-dried blood meal and plasma. The simple diets only contained fish meal and whey as alternative protein sources (Table 1). Hemicell® was added to the diets at a rate of 0 and .05%. Diets in Phase 3 (d 21 to 42) were simple corn-SBM based diets with 0 and .05% Hemicell® added. Pigs and feeders were weighed weekly for determination of rate and efficiency of gain.

Experiment 2. Following a 3-wk adjustment period post-weaning (Phases 1 and 2), 117 pigs were blocked by weight, sex and genotype and allotted to three dietary treatments in a randomized block design with 10 pen replicates per treatment. Yorkshires, Hampshires, and Hampshire x Yorkshire crosses were used. Sexes and breeds were evenly distributed across treatments with three to four pigs per pen. A common corn-SBM based diet was fed to all pigs during the adjustment period. In the 3-wk experimental period, dietary treatments were: 1) a fortified corn-SBM diet as the control, 2) the control diet with soybean oil added (2%) to increase ME by approximately 100 kcal/kg, and 3) the control diet with Hemicell® (Table 2). Experimental diets were fed in meal form. Feed and water were offered ad libitum. The pens were elevated nursery decks in a temperature controlled room (85° F). Pigs and feeders were weighed weekly for determination of ADG, ADFI, and F:G.

Data were analyzed as a randomized complete block design using analysis of variance procedures as described by Steel and Torrie (1997). Pen served as the experimental unit. Data in Exp. 1 were analyzed as a 2 x 2 factorial with orthogonal contrasts used to compare treatment means. The main effect of diet complexity and Hemicell® and their interaction were tested. In Exp. 2, pre-planned non-orthogonal contrasts were used to compare treatment means.

Results and Discussion

Experiment 1. Pigs fed diets with complex protein sources, such as spray-dried blood meal and plasma, performed as expected when compared with pigs fed simple diets (Table 3). During Phase 1, pigs fed complex diets gained faster and were more efficient than their counterparts ($P<.05$). Likewise, pigs fed diets containing Hemicell® showed a consistent trend towards improved feed efficiency during Phases 1 and 2, and were significantly ($P<.05$) more efficient when fed simple diets during Phase 3. Overall, pigs fed complex diets during Phases 1 and 2 had lower ($P<.10$) feed:gain ratios. By the end of the 42-d test period, pigs fed diets with Hemicell® were 4% more efficient in converting feed to body weight gain than pigs not fed Hemicell® .

These results in nursery pigs concur with data from similar trials in growing/finishing pigs. An unpublished study conducted by the Taiwan Sugar Corporation in 1997 found that pigs fed diets with 5% crude fiber with added Hemicell® were more efficient ($P<.05$) in converting feed to gain compared with pigs fed diets with only 3% crude fiber without Hemicell® . Also, Hahn et al. (1995) found that pigs fed diets with Hemicell® showed consistent trends toward improved feed efficiency compared with pigs fed similar diets with no added Hemicell® . From our observations, we conclude that the addition of Hemicell® to diets for weanling pigs improved efficiency of feed utilization in the late nursery phase.

Experiment 2. During the first week of the experimental period, all pigs grew at similar rates and consumed similar amounts of feed. In the second week, pigs fed diets with added soybean oil gained faster and were ($P<.10$) more efficient than pigs fed the control diet. Also, in the first 2-wk period, pigs fed diets with added Hemicell® gained similarly ($P>.50$) to those fed diets with soybean oil and were ($P<.10$) more efficient than the pigs fed control diets. Through the third week, results were consistent with previous weeks as pigs fed diets with added Hemicell® and soybean oil gained faster and had lower feed conversion ratios compared with the control pigs (Table 4). These results indicate that Hemicell® may break down galactomannans in soybean meal and allow nursery pigs to better utilize energy from corn-SBM diets.

Along with the advantages in growth performance experienced by pigs fed corn-SBM based diets with Hemicell® , an improvement in cost per pound of gain may be recognized. A cost analysis of the three experimental diets revealed a decrease ($P<.10$) in cost per pound of gain of pigs fed diets with Hemicell® compared with pigs fed diets with added soybean oil and pigs fed the control diet. These conclusions are predictable with regard to the improved feed efficiency of the pigs fed diets with Hemicell® over pigs fed the control diet. But, with the increased cost of high-quality energy sources, such as soybean oil, pigs fed diets with added fat were more expensive to feed in this experiment even considering the increase in growth performance.

Implications

Addition of Hemicell® to corn-soybean meal based diets improved performance of pigs during the late nursery stage. Furthermore, the improvement in pig performance associated with Hemicell® addition appears to be comparable to that observed with supplemental fat. These results suggest that Hemicell® may improve the digestibility of corn-soybean meal diets for weanling pigs. Further research is warranted concerning the mode of action of Hemicell® in improving weanling pig performance.

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Table 1. Composition of diets in Experiment 1.

	Phase 1		Phase 2		Phase 3
Ingredient, %	C[1]	S[1]	C[1]	S[1]	S[1]
Corn	40.95	30.58	49.12	48.85	64.60
Soybean meal, dehulled	15.65	31.42	24.99	34.67	29.87
Whey	20.00	20.00	10.00	10.00	
Plasma, spray-dried	5.00				
Blood meal, spray-dried	1.50		2.00		
Fish meal	5.00	5.00	2.50		
Lactose	5.00	5.00	5.00		
Dicalcium phosphate	1.19	1.26	1.71	1.80	1.86
Limestone	.33	.24	.42	.67	.76
Salt	.20	.20	.20	.20	.30
Soybean oil	3.25	4.40	3.15	2.95	2.00
L-lysine-HCl		.02			
DL-Methionine	.15	.10	.10	.05	
OSU Vit & Min premix	.30	.30	.30	.30	.30
Flavor	.10	.10			
Ethoxyquin	.03	.03	.03	.03	.03
Antibiotic	1.00	1.00	.13	.13	.13
Zinc Oxide	.30	.30	.30	.30	
Copper Sulfate					.10
Corn starch/Hemicell® [a]	.05	.05	.05	.05	.05
Calculated Analysis					
ME, kcal/kg	3310	3310	3310	3310	3310
Lysine, %	1.50	1.50	1.30	1.30	1.10
Ca, %	.90	.90	.85	.85	.80
P, %	.80	.80	.75	.75	.70
Hemicell®	-/+	-/+	-/+	-/+	-/+

[1]C =complex diet, S =simple diet.

[a]Hemicell® was added at the expense of corn starch.

Table 2. Composition of diets in Experiment 2.

	Treatment

Ingredient, %	Control	Soybean oil	Hemicell®
Corn, dent grain	62.38	60.18	62.38
Soybean meal, dehulled	34.36	34.55	34.36
Corn starch	.05	.05	
Dicalcium phosphate	1.94	1.97	1.94
Limestone	.39	.37	.39
Salt	.50	.50	.50
Soybean oil		2.00	
OSU Vit & Min premix	.25	.25	.25
Antibiotic	.13	.13	.13
Hemicell® [a]			.05
Calculated Analysis			
ME, kcal/kg	3297	3396	3295
Lysine, %	1.20	1.20	1.20
Ca, %	.75	.75	.75
P, %	.65	.65	.65
Hemicell® , %			.05

[a]Hemicell® was added at the expense of corn starch.

Table 3. Effects of diet complexity and Hemicell® on growth performance of weanling pigs (Experiment 1).

Diet:	Complex		Simple		
Hemicell:	0	.05%	0	.05%	CV
Number of pigs	39	39	39	39	
Initial weight, lb	13.77	13.85	13.73	13.76	
Final weight, lb	48.42	46.89	46.30	47.99	
Phase 1					
ADG lb[a]	.514	.528	.496	.446	9.57
ADF, lb	.666	.662	.635	.623	8.39
F:G[ac]	1.292	1.253	1.292	1.401	5.50
Phase 2					
ADG, lb	.959	.938	.929	.991	7.38
ADF, lb[a]	1.399	1.325	1.421	1.434	5.97
F:G	1.456	1.411	1.540	1.459	7.17
Phase 3					
ADG, lb	1.077	1.096	1.074	1.138	7.47
ADF, lb	2.098	2.038	2.118	2.083	6.11

F:G[b]	1.949	1.827	1.949	1.830	4.55
Overall					
ADG, lb	.845	.857	.831	.861	5.70
ADF, lb	1.368	1.327	1.370	1.371	4.62
F:G[b]	1.619	1.548	1.654	1.595	3.32

[a]Main effect of diet type (P<.10).

[b]Main effect of Hemicell® (P<.10).

[c]Diet complexity x Hemicell® interaction (P<.10).

Table 4. Effects of Hemicell® and soybean oil on growth performance of weanling pigs[a] (Experiment 2).

	Treatment			
Item	Control	Soybean oil	Hemicell®	CV
Number of pigs	39	39	39	
Initial weight, lb	30.05	30.11	29.86	
Final weight, lb	54.62	55.11	55.12	
Week 1				
ADG, lb	.903[b]	.896[b]	.942[b]	12.57
ADF, lb	1.657[b]	1.655[b]	1.646[b]	6.25
F:G	1.841[b]	1.848[b]	1.770[b]	8.86
Week 2				
ADG, lb	1.354[b]	1.434[b]	1.348[b]	10.25
ADF, lb	2.143[b]	2.119[b]	2.066[b]	5.34
F:G	1.579[b]	1.489[c]	1.535[b]	6.97
Week 3				
ADG, lb	1.337[b]	1.333[b]	1.410[b]	9.95
ADF, lb	2.544[b]	2.476[b]	2.523[b]	5.46
F:G	1.935[b]	1.873[b]	1.829[b]	9.76
Overall				
ADG, lb	1.197[b]	1.219[b]	1.231[b]	5.58
ADF, lb	2.106[b]	2.075[b]	2.069[b]	4.11
F:G	1.759[b]	1.702[c]	1.683[c]	3.05

[a]Least squares means of 10 pens/treatment (3 to 4 pigs/pen).

[b,c]Means within a row with different superscripts differ ($P<.10$).