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**THE EFFECT OF NOVEL CARBOHYDRATE SOURCES
ON NURSERY PIG GROWTH PERFORMANCE**

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Summary

Two growth assays were conducted to determine the effects of novel carbohydrate sources in Phase I and II starter diets on growth performance. In Exp. 1, 90 weanling pigs (avg initial body wt of 12.4 lb and 18 d of age) were used in a 38-d trial evaluating three carbohydrate sources: corn, tapioca, and rice flour. The carbohydrate sources were substituted for corn in diets formulated to 1.55 and 1.3% lysine for Phase I (d 0 to 10) and Phase II (d 10 to 24), respectively. All pigs were fed the same sorghum-soybean meal-based diet from d 24 to 38 postweaning. For the overall experiment, pigs fed rice flour had greater average daily gain (ADG) compared with those fed tapioca, with those fed the diet containing corn having intermediate ADG. Pigs fed rice flour had improved feed to gain ratio (F/G) compared with those fed either corn or tapioca. In Exp. 2, 60 weanling pigs (avg initial body wt of 8.6 lb and 17 d of age) were used in a similar study to evaluate corn, ground sorghum, and roasted sorghum as the primary carbohydrate sources in Phase I and II diets. During d 0 to 10 postweaning, pigs fed the corn diet had greater average daily feed intake (ADFI) than those fed the sorghum-based diets; however, no other differences in growth performance were observed during the experiment. These results suggest similar growth performance of starter pigs fed tapioca, sorghum, and roasted sorghum compared with those fed corn-based diets. However, pigs fed rice flour had improved F/G compared with those fed either corn or tapioca. Therefore, decisions on the use of novel carbohydrate sources in Phase

I and II starter diets should be based on their price and availability relative to corn.

(Key Words: Starter, Pigs, Tapioca, Sorghum, Rice, Roasting, Performance.)

Introduction

Corn is a traditional carbohydrate source used in diets of nursery pigs. However, swine producers may have access to alternative carbohydrate products. Therefore, the objective of the two experiments reported herein was to examine the nutritional value of novel carbohydrate sources in diets for nursery pigs.

Procedures

In Exp. 1, 90 weanling pigs (initial body wt of 12.4 lb and 18 d of age) were allotted by weight, sex, and ancestry, with six pigs per pen and five pens per treatment. Dietary treatments included a corn-soybean meal-based control diet or diets in which the corn was replaced by either tapioca or rice flour (Table 1). In Exp. 2, 60 weanling pigs (initial body wt 8.6 lb and 17 d of age) were allotted by weight, sex, and ancestry, with five pigs per pen and four pens per treatment. Dietary treatments included the same corn-based control diet used in Exp. 1 or diets in which the corn was replaced by either ground sorghum or roasted sorghum. To obtain the roasted sorghum, sorghum grain was ground and reconstituted to 30% moisture. The product then was pelleted and passed through a Jet-Pro® roaster with an exit temperature of 260°F.

Both experiments were conducted as 38-d growth assays. At initiation of the experiments, pigs were given a Phase I diet (d 0 to 10 postweaning) formulated to 1.55% lysine, .9% Ca, and .8% P. Phase II diets (d 10 to 24) were formulated to 1.3% lysine, .9% Ca, and .8% P. On d 24 postweaning, all pigs were switched to the same sorghum-based Phase III diet with 1.15% lysine, .9% Ca, and .8% P. All diets were fed in pelleted form.

Pigs were housed in 4-ft × 5-ft pens with woven-wire flooring. Room temperatures were 90, 87, 84, 80, and 79°F for wk 1 to 5, respectively. Each pen had a self-feeder and nipple waterer to allow ad libitum consumption of feed and water. The pigs were weighed on d 0, 10, 24, and 38 of the experiment to determine ADG, ADFI, and F/G.

Results and Discussion

Experiment 1. No differences were observed for ADG, ADFI, or F/G (Table 2) during the Phase I feeding period (d 0 to 10 postweaning). However, pigs fed the corn treatment showed a trend for greater ADFI ($P < .09$) compared to pigs fed tapioca and rice flour. In Phase II (d 10 to 24 postweaning), pigs fed rice flour and tapioca had improved F/G compared to pigs fed corn ($P < .01$), and pigs fed rice flour tended to

have improved F/G compared to pigs fed tapioca ($P < .09$). Phase I and II combined data indicated that pigs fed rice flour and tapioca had better F/G compared to pigs fed corn primarily because of the superior F/G for pigs fed the diet with rice flour ($P < .01$). Data from the overall trial (d 0 to 38 postweaning) suggested that pigs fed rice flour had improved F/G compared to pigs fed corn and tapioca ($P < .01$).

Experiment 2. Pigs fed the diet with corn during Phase I (d 0 to 10 postweaning) had greater ADFI ($P < .04$) compared with those fed the sorghum treatments (Table 3). No differences occurred in ADG or F/G in the Phase I period. During Phases II, III, and for the overall feeding period, no differences occurred in growth performance among pigs fed the three carbohydrate sources.

In summary, novel carbohydrate sources, other than corn, are viable alternatives in phase-feeding programs for nursery pigs. In Exp. 1, pigs fed rice flour were the most efficient. In Exp. 2, pigs fed either sorghum source had similar performance to those fed the corn diet. Therefore, if carbohydrate quality is good, these sources can be substituted for corn depending on price and availability. However, the added expense of roasting sorghum did not result in improved performance of weaned pigs.

Table 1. Diet Composition, %

Ingredient	Phase I ^{ab} (d 0 to 10)	Phase II ^c (d 10 to 24)	Phase III ^d (d 24 to 38)
Corn	38.05	49.87	---
Sorghum	---	---	60.22
Soybean meal	15.00	20.00	33.60
Dried whey	20.00	20.00	---
Lactose	10.00	---	---
Spray-dried plasma protein	8.00	---	---
Spray-dried blood meal	2.00	2.00	---
Soybean oil	2.00	2.00	2.00
Monocalcium phosphate	2.16	1.88	1.97
Limestone	.57	.64	.92
Vit/Min/Ab ^e	1.87	3.33	1.29
Lysine-HCl	.18	.21	---
DL-methionine	.17	.07	---
Total	100.00	100.00	100.00

^aFor Exp. 1, tapioca and rice flour were used to replace corn, lysine-HCl, monocalcium phosphate, and limestone so that all Phase I diets had 1.55% lysine, .9% Ca, and .8% P.

^bFor Exp. 2, sorghum and roasted sorghum were used to replace corn, lysine-HCl, monocalcium phosphate, and limestone so that all Phase I diets had 1.55% lysine, .9% Ca, and .8% P.

^cPhase II diets were formulated to contain 1.3% lysine, .9% Ca, and .8% P using the same carbohydrate sources that were in Phase I diets.

^dThe common Phase III diet was formulated to 1.15% lysine, .9% Ca, and .8% P. This diet was fed from d 24 to 38 of both experiments.

^eVit/Min = KSU vitamin and mineral premixes. Ab = antibiotic (150 g apramycin/ton of diet in Phase I, 50 g carbadox/ton of diet in Phase II, and 50 g carbadox/ton of diet in Phase III).

Table 2. Novel Carbohydrate Sources for Weanling Pigs (Exp. 1)^a

Item	Corn	Tapioca	Rice flour	CV	Contrasts ^b	
					1	2
Phase I (d 0 to 10)						
ADG, lb	.60	.53	.55	13.8	-- ^c	--
ADFI, lb	.67	.61	.59	10.9	.09	--
F/G	1.12	1.15	1.07	10.3	--	--
Phase II (d 10 to 24)						
ADG, lb	.98	.98	1.06	8.4	--	--
ADFI, lb	1.42	1.34	1.38	7.5	--	--
F/G	1.45	1.37	1.30	4.5	.01	.09
Phases I and II (d 0 to 24)						
ADG, lb	.82	.79	.84	6.2	--	--
ADFI, lb	1.11	1.04	1.05	7.2	--	--
F/G	1.35	1.32	1.25	2.5	.01	.01
Overall (d 0 to 38)						
ADG, lb	.86	.82	.90	6.1	--	.04
ADFI, lb	1.38	1.30	1.35	5.7	--	--
F/G	1.60	1.59	1.50	2.5	.01	.01

^aA total of 90 weanling pigs (six pigs/pen and five pens/treatment) with an average initial body wt of 12.4 lb and an average final body wt of 45 lb.

^bContrasts were: 1) corn vs tapioca and rice flour; and 2) tapioca vs rice flour.

^cDashes = P > .10.

Table 3. Novel Carbohydrate Sources for Weanling Pigs (Exp. 2)^a

Item	Corn	Ground sorghum	Roasted sorghum	CV	Contrasts ^b	
					1	2
Phase I (d 0 to 10)						
ADG, lb	.62	.57	.53	14.4	-- ^c	--
ADFI, lb	.57	.53	.50	6.0	.04	--
F/G	.92	.93	.94	11.0	--	--
Phase II (d 10 to 24)						
ADG, lb	.84	.86	.80	12.1	--	--
ADFI, lb	1.14	1.18	1.12	10.9	--	--
F/G	1.36	1.37	1.40	4.5	--	--
Phases I and II (d 0 to 24)						
ADG, lb	.75	.74	.69	10.7	--	--
ADFI, lb	.90	.91	.86	9.1	--	--
F/G	1.20	1.23	1.25	5.1	--	--
Overall (d 0 to 38)						
ADG, lb	.92	.91	.89	7.2	--	--
ADFI, lb	1.28	1.33	1.29	7.5	--	--
F/G	1.39	1.46	1.45	5.6	--	--

^aA total of 60 weanling pigs (five pigs/pen and four pens/treatment) with an average initial body wt of 8.6 lb and an average final body wt of 44.5 lb.

^bContrasts were: 1) corn vs sorghum sources; and 2) ground sorghum vs roasted sorghum.

^cDashes = P > .10.