EXTRUDED SORGHUM AND SOYBEANS FOR NURSERY PIGS

B. T. Richert, J. D. Hancock, and R. H. Hines

Summary

Two experiments were conducted to determine the effects of extruding sorghum and soybeans for weanling pigs. The first experiment involved 66 piglets with an average age of 19 d and average weight of 10.8 lb. Two diets were fed in meal form. Treatment 1 was ground sorghum mixed with extruded soybeans, and Treatment 2 was prepared by extruding the mixture of ground sorghum and extruded soybeans. Extrusion of the sorghum-soybeans mixture increased average daily gain (ADG) and improved feed/gain (F/G) for d 0 to 14 and overall (d 0 to 28) compared to the ground sorghum treatment. In Exp. 2, 48 piglets averaging 23 d of age and average weight 13.0 lb were used to determine the potential for increased pig performance by double extrusion of soybeans. Diets were similar to those used in Exp. 1, with treatments of 1) ground sorghum-extruded soybeans, 2) extruded mixture of ground sorghum and extruded soybeans, and 3) ground sorghum with double-extruded soybeans. The extruded sorghum-soybeans mixture and double-extruded soybeans did not affect ADG from d 0 to 14, although there was a numerical improvement in F/G compared to the ground sorghum-extruded soybeans treatment. For d 14 to 28 and overall (d 0 to 28), average daily feed intake was reduced by extrusion of the sorghum-extruded soybeans mixture and double-extruded soybeans, with no effect on ADG or F/G. Extrusion of sorghum improved growth performance of nursery-age pigs, but more information is needed to define the processing conditions and end-product characteristics that yield consistent improvements in nutritional value.

(Key Words: Sorghum, Soybeans, Extrusion, Processing, Nursery.)

Introduction

Research reported in the past two KSU Swine Day Reports (Reports of Progress No. 610 and 641) demonstrated increased nutrient digestibility and improved efficiency of gain in finishing pigs fed extruded sorghum and soybeans compared to ground sorghum and soybean meal. However, the use of extruded cereal grains in diets for nursery pigs has not been thoroughly investigated. Therefore, two experiments were conducted to determine the nutritional value of extruded sorghum and soybeans for early-weaned pigs.

Procedures

In Exp. 1, 66 weanling pigs, averaging 19 d of age and 10.8 lb initial weight, were used in a 28-d growth assay to evaluate the effects of extruded sorghum and soybeans in nursery diets. Pigs were blocked by weight and randomly allotted to treatment based on sex and ancestry. Treatments were 1) ground sorghum and extruded soybeans, and 2) extruded mixture of ground sorghum and extruded soybeans. The diets were formulated to 1.6% lysine, .9% Ca, and .8% P for d 0 to 14, and 1.3% lysine, .8% Ca, and .7% P for d 14 to 28 (Table 1). All diets were fed in meal form. Soybeans were extruded in an Insta-Pro® extruder, using a double flight screw with 6 and 6E steam locks on the barrel. The exit orifice was 5/16 in. The soybeans were processed with a barrel temperature of 326°F at 1,200 lb/hr. Ground sorghum was prepared by grinding in a Jacobson Pulverator® hammermill equipped

with a 3/16 in. screen. Extruded sorghum was prepared by mixing the ground sorghum with extruded soybeans and extruding the blend using a single flight screw with a compression head and multihole plate (1/8 in. orifices). The sorghum-soybeans blend was processed with a barrel temperature of 146°F at 1,320 lb/hr.

Pigs were housed in 3.5 ft × 5 ft pens with rubber coated, expanded metal flooring. Room temperatures were 90, 86, 82, and 78°F for wk 1 to 4, respectively. Each pen had a self-feeder and nipple waterer to allow ad libitum consumption of feed and water. There were five pigs per pen in three blocks and six pigs per pen in three blocks. Pigs and feeders were weighed weekly to allow calculation of average daily gain (ADG), average daily feed intake (ADFI), and feed/gain (F/G).

In Exp. 2, 48 weanling pigs, averaging 23 d of age and 13.0 lb initial weight, were used in a 28-d growth assay to determine if benefits from extruding sorghum with soybeans in Exp. 1 resulted simply from extruding the soybeans twice. Treatments were 1) ground sorghum and extruded soybeans, 2) extruded mixture of ground sorghum and extruded soybeans, and 3) ground sorghum with double-extruded soybeans. All diets were fed in meal form. Soybeans and sorghum were extruded as in Exp. 1. For double-extruded soybeans, the extruded soybeans were re-extruded with a lower barrel temperature (245°F). The average barrel temperature while extruding the sorghum-soybeans blend was 140°F. Pigs were blocked by weight and randomly allotted to treatment based on sex and ancestry. The pigs were housed and managed as in Exp. 1, with four pigs per pen and four pens per treatment.

Results and Discussion

A major concern in nutrition of weanling pigs is to maximize feed intake, especially immediately postweaning. Thus, we were concerned that the puffing and reduced bulk density of diets with extruded sorghum could result in decreased nutrient intake. In Exp. 1, ADFI for d 0 to 14 was not reduced by extrusion of the sorghum ($P>.20$). However, ADG and F/G were improved by 20% ($P<.01$) and 13% ($P<.05$), respectively, when extruded sorghum was used in place of ground sorghum. Similar trends were noted for d 14 to 28, although not statistically significant ($P>.10$). Overall (d 0 to 28), ADFI was not affected, but ADG was improved by 12% and F/G was improved by 10% with extrusion of the sorghum ($P<.05$).

For Exp. 2, ADG and ADFI were not affected by treatment ($P>.16$) from d 0 to 14, although there was a numerical improvement in F/G for pigs fed the extruded sorghum and double-extruded soybeans treatments. For d 14 to 28, ADG and F/G were not affected by treatment ($P>.20$), but ADFI was reduced by 8% ($P<.05$) for pigs fed the extruded sorghum and double-extruded soybeans treatments compared to the ground sorghum-extruded soybeans treatment. Overall (d 0 to 28), ADG and F/G were not affected by treatment ($P>.20$), but ADFI was reduced ($P<.05$) for the extruded sorghum and double-extruded soybeans treatments compared to the ground sorghum-extruded soybeans treatment.

In conclusion, results of the two experiments were mixed, with improved rate and efficiency of gain from extrusion of sorghum in Exp. 1, but no effect on rate or efficiency of gain in Exp. 2. These findings merit further investigation, especially to identify the processing conditions, and physical and chemical characteristics of the extruded product that give consistent improvements in growth performance of nursery-age pigs.

Table 1. Diet Composition (Exp. 1 and 2)

Item, %	Phase 1[a]	Phase 2[b]
Sorghum[c]	31.15	43.06
Extruded soybeans	24.77	31.11
Spray-dried porcine plasma	10.00	—
Spray-dried blood meal	—	2.50
Dried whey (edible grade)	30.00	20.00
Lysine-HCl	.10	.10
D, L-methionine	.15	.05
Monocalcium phosphate (21% P)	1.73	1.24
Limestone	.45	.64
Vitamins and minerals[d]	.55	.55
Salt	—	.25
Antibiotic[e]	1.00	.50
Chromic oxide	.10	—
Total	100	100

[a]Diets for d 0 to 14 were formulated to 1.60% lysine, 23% CP, .9% Ca, and .8% P.
[b]Diets for d 14 to 28 were formulated to 1.30% lysine, 20% CP, .8% Ca, and .7% P.
[c]Extruded sorghum was substituted on an equal weight basis for ground sorghum.
[d]KSU vitamin mix (.25%), KSU mineral mix (.15%), Se mix (.05%), and copper sulfate (.10%).
[e]Day 0 to 14 antibiotic supplied 50 g carbadox per ton of diet. Day 14 to 28 antibiotic supplied 100 g chlortetracycline, 100 g sulfathiazole, and 50 g penicillin per ton of diet.

Table 2. Effects of Extruded Sorghum and Soybeans on Nursery Pigs (Exp. 1)[a]

Item	Ground sorghum	Extruded sorghum	CV
d 0 to 14			
ADG, lb[c]	.60	.72	8.7
ADFI, lb	.84	.88	4.6
F/G[b]	1.40	1.22	7.3
d 14 to 28			
ADG, lb	.92	.97	8.5
ADFI, lb	1.51	1.51	5.7
F/G	1.64	1.56	19.2
d 0 to 28			
ADG, lb[b]	.75	.84	6.0
ADFI, lb	1.16	1.18	5.0
F/G[b]	1.55	1.40	8.2

[a]A total of 66 pigs (five or six pigs/pen and six pens/treatment) with an average initial weight of 10.8 lb.
[bc]Ground sorghum vs extruded sorghum ($P<.05$ and $P<.01$, respectively).

Table 3. Effects of Extruded Sorghum and Soybeans on Nursery Pigs (Exp. 2)[a]

Item	G-sorghum + ESB[b]	E-sorghum + ESB	G-sorghum + double-ESB	CV
d 0 to 14				
ADG, lb	.71	.73	.72	13.7
ADFI, lb	.99	.94	.93	13.6
F/G	1.39	1.29	1.29	8.5
d 14 to 28				
ADG, lb	1.15	1.05	1.09	11.0
ADFI, lb[c]	1.85	1.65	1.75	5.1
F/G	1.61	1.57	1.61	6.8
d 0 to 28				
ADG, lb	.93	.89	.90	11.0
ADFI, lb[c]	1.42	1.25	1.34	5.1
F/G	1.53	1.40	1.49	7.0

[a]A total of 48 pigs (four pigs/pen and four pens/treatment) with an average initial weight of 13.0 lb.
[b]G-sorghum = ground sorghum, ESB = extruded soybeans, and E-sorghum = extruded sorghum.
[c]Ground sorghum-extruded soybeans vs extruded mixture of sorghum and extruded soybeans and ground sorghum-double-extruded soybeans ($P<.05$).