Kansas Agricultural Experiment Station Research Reports

Volume 0
Issue 10 *Swine Day (1968-2014)*

Article 390

1989

The effect of dietary energy density and porcine somatotropin on apparent digestibility and retention of nutrients in finishing swine (1989)

G R. Stoner

B R. Schricker

Jim L. Nelssen

See next page for additional authors

The effect of dietary energy density and porcine somatotropin on apparent digestibility and retention of nutrients in finishing swine (1989)

Authors

G R. Stoner, B R. Schricker, Jim L. Nelssen, Robert D. Goodband, and Robert H. Hines

THE EFFECT OF DIETARY ENERGY DENSITY AND PORCINE SOMATOTROPIN ON APPARENT DIGESTIBILITY AND RETENTION OF NUTRIENTS IN FINISHING SWINE

G. R. Stoner, J. L. Nelssen, R. D. Goodband, R. H. Hines, and B. R. Schricker[1]

Summary

Sixteen barrows were used in a metabolism study (avg wt of 101.2 lb) to evaluate the effect of dietary energy density and porcine somatotropin (pST) on apparent digestibility and retention of nutrients in finishing pigs. This study was designed as a split-plot with 4 mg pST/d or placebo injection as whole plot treatments and four dietary energy densities (1.37, 1.48, 1.60, and 1.71 Mcal ME/lb) and period as the subplot treatments. Increasing dietary energy density increased apparent digestibility of dry matter, gross energy, and nitrogen, but had no effect on nitrogen retention. Porcine somatotropin administration had no effect on apparent digestibility of nutrients; however, percentage nitrogen retention was increased 42% compared to control pigs.

(Key Words: Porcine Somatotropin, Nitrogen Retention, Pig, Digestibility.)

Introduction

Daily injection of porcine somatotropin (pST) has been shown to improve growth rate and feed efficiency of finishing pigs. Researchers also have reported significant increases in muscle growth in pigs treated with pST. However, the degree of response to pST appears to be associated with the nutrient density of the diet. Chronic administration of pST to pigs depresses feed intake. Thus, it has been suggested this reduction in feed intake may limit the response to pST. Considering the relationship between dietary nutrient density and pST response as well as the effect of pST on lean tissue growth, this experiment was designed to study the interactive effects of dietary energy density and pST on apparent digestibility and retention of nutrients in finishing pigs.

Experimental Procedures

The composition of the experimental diets is shown in Table 1 and their nutrient composition in Table 2. Lysine and crude protein levels were held constant, while energy density was increased. The calculated energy densities, expressed as Mcal ME/lb of feed were 1.37, 1.48, 1.60, or 1.71. The calculated g lysine/Mcal ME were 4.0, 3.7, 3.4, or 3.2.

This study was a split-plot design with two treatments (daily injection of placebo or daily injection of 4 mg pST) as the whole-plot and four dietary treatments and four time periods as the subplots.

[1]This study was sponsored in part by Pitman-Moore, Inc., Terre Haute, IN 47808.

Table 1. Composition of Experimental Diets

Ingredient, %	Energy density, Mcal ME/lb			
	1.37	1.48	1.60	1.71
	1.20[a]	1.20[a]	1.20[a]	1.20[a]
Corn	55.33	64.58	58.17	50.91
Soybean meal (48.5)	29.60	28.00	29.00	30.30
Solka floc	7.70	--	--	--
Soybean oil	2.00	2.00	7.40	13.40
Dicalcium phosphate	3.04	3.00	3.07	3.09
Limestone	.90	.95	.90	.87
L-lysine-HCl	.16	.20	.19	.16
Threonine	.01	.01	.01	.01
Tryptophan	.01	.01	.01	.01
Salt	.50	.50	.50	.50
Selenium premix[b]	.05	.05	.05	.05
Vitamin premix[c]	.50	.50	.50	.50
Trace mineral premix[d]	.20	.20	.20	.20

[a]Percentage dietary lysine.
[b]Contained 123 mg Se/lb premix.
[c]Each lb of premix contained: .80 million IU vitamin A, 60,000 IU vitamin D_3, 4,000 IU vitamin E, 900 mg riboflavin, 310 mg menadione, 2,400 mg d-pantothenic acid, 5,000 mg niacin, 92,200 mg choline chloride, 4.4 mg vitamin B_{12}.
[d]Each lb of premix contained 25 g Mn, 45.4 g Fe, 5 g Cu, 91 g Zn, .7 g I, and .45 g Co.

Sixteen crossbred barrows averaging 101.2 lb were assigned randomly to whole-plot pST treatments. Pigs within each whole-plot were then assigned randomly to sub-plot treatment combinations. Each dietary treatment was represented twice per period within each whole-plot. All four dietary treatments were evaluated for each pig.

Pigs were housed in individual metabolism crates. Feed and water were offered ad libitum. Each time period (10 d) was divided into 5 d for adaptation and 5 d for collection.

Results and Discussion

Interaction effects between pST, dietary energy density, and period were not significant. Main effect means for pST and dietary energy density are reported in Table 3. The pST by diet interaction means are shown in Table 4.

Dry matter digestibility and gross energy digestibility both increased with increasing energy density; however, this was primarily the result of the essentially non-digestible solka floc contained in the low energy diet (see Table 1). Increasing dietary energy density resulted

Table 2. Nutrient Composition of Experimental Diets

Ingredient, %	Energy density, Mcal ME/lb 1.37 1.20[a]	1.48 1.20[a]	1.60 1.20[a]	1.71 1.20[a]
Calculated to contain:				
Crude protein, %	19.19	19.27	19.19	19.18
Lysine, %	1.20	1.20	1.20	1.20
Threonine, %	.80	.81	.80	.81
Tryptophan, %	.23	.23	.23	.24
Calcium, %	1.10	1.10	1.10	1.10
Phosphorus, %	.90	.90	.90	.90
g lysine/Mcal ME[b]	4.0	3.7	3.4	3.2
Analysis				
Gross energy, Mcal/lb	1.87	1.87	2.02	2.13
Crude protein, %	19.06	19.19	19.25	19.12
Lysine, %	1.16	1.20	1.21	1.19
Particle size analysis				
Mean particle size, microns	554	528	535	542

[a]Percentage dietary lysine.
[b]Expressed as g lysine/Mcal ME in a kg of diet.

in improved nitrogen digestibility (linear, P<.01) and an associated decrease in fecal nitrogen (g/d). Dietary treatment had no influence on apparent biological value or nitrogen retention.

Porcine somatotropin had no effect on percentage dry matter digestibility, gross energy digestibility, or nitrogen digestibility. Daily pST administration decreased ADFI, and thus, nitrogen intake also was decreased (P<.01). As a result of the decrease in nitrogen intake and no difference in nitrogen digestibility, fecal nitrogen (g/d) also was decreased (P<.10). Daily injection of pST resulted in a dramatic reduction (P<.01) in urinary nitrogen (g/d) and a consequent increase (P<.01) in both apparent biological value and percentage nitrogen retained.

The results of this study indicate that pST exerts its effect on lean tissue growth by dramatically altering apparent biological value, and thus nitrogen retention. Nitrogen retention of pigs administered pST compared to control pigs was increased 22 and 42% expressed as g/d and percentage of nitrogen intake, respectively.

Table 3. Effect of Porcine Somatotropin (pST) Administration and Dietary Energy Density on Apparent Digestibility and Nitrogen Retention of Finishing Pigs: Main Effect Means

Item	pST 4 mg · d^{-1}	Placebo	Dietary energy density, Mcal ME/lb 1.37 1.20[a]	1.48 1.20[a]	1.60 1.20[a]	1.71 1.20[a]	CV
Feed intake[b], lb/d	2.26	2.61	5.54	5.32	5.41	5.13	9.8
Dry matter digestibility[c], %	83.89	83.17	78.00	84.83	85.28	86.02	2.5
Gross energy digestibility[d], %	86.25	85.82	80.66	87.01	87.83	88.64	2.2
Nitrogen intake[e], g/d	69.43	79.88	76.86	74.53	75.78	71.43	12.0
Fecal nitrogen[f], g/d	10.42	11.87	12.44	10.99	11.16	9.99	15.8
Urine nitrogen[g], g/d	15.64	32.90	24.41	24.47	25.22	22.98	12.1
Nitrogen retained[h], g/d	43.37	35.44	39.96	39.06	40.09	38.51	15.1
Nitrogen digestibility[i], %	84.94	85.01	83.71	85.15	85.08	85.95	2.8
Biological value[j], %	73.89	52.13	63.20	61.97	63.23	63.65	6.1
Nitrogen retained[k], %	62.70	44.29	52.82	52.80	53.72	54.64	6.1

[a]Percentage dietary lysine.
[b]pST effect P<.01; dietary energy density effect was linear (P<.05); period effect was linear (P<.01).
[c]Dietary energy density effect was linear (P<.01) and quadratic (P<.01); period effect was linear (P<.01).
[d]Dietary energy density effect was linear (P<.01) and quadratic (P<.01).
[e]pST effect P<.01; dietary energy density effect was linear (P<.10); period effect was linear (P<.01).
[f]pST effect P<.10; dietary energy density effect was linear (P<.01); period effect was linear (P<.10).
[g]pST effect P<.01; period effect was linear (P<.01).
[h]pST effect P<.05; period effect was linear (P<.01) and quadratic (P<.10).
[i]Dietary energy density effect was linear (P<.01); period effect was linear (P<.01).
[j]pST effect P<.01; period effect was linear (P<.01).
[k]pST effect P<.01; period effect was linear (P<.01) and quadratic (P<.10).

Table 4. Effect of Porcine Somatotropin (pST) Administration and Dietary Energy Density on Apparent Digestibility and Nitrogen Retention of Finishing Pigs: pST × Dietary Energy Density Interaction Means

Item	4 mg pST · d^{-1}				Placebo				CV
	1.34[a]	1.48[a]	1.60[a]	1.71[a]	1.37[a]	1.48[a]	1.60[a]	1.71[a]	
Dry matter digestibility[b], %	78.13	85.23	85.75	86.45	77.86	84.44	84.80	85.60	2.5
Gross energy digestibility[c], %	80.63	87.18	88.17	89.03	80.70	86.85	87.48	88.25	2.2
Nitrogen intake[d], g/d	72.10	71.49	68.21	65.91	81.63	77.57	83.34	76.95	12.0
Fecal nitrogen[e], g/d	12.07	10.02	10.36	9.23	12.82	11.96	11.97	10.74	15.8
Urine nitrogen[f], g/d	15.64	17.47	15.30	14.15	33.18	31.48	35.15	31.81	12.1
Nitrogen retained[g], g/d	44.39	44.00	42.56	42.53	35.53	34.13	37.61	34.50	15.1
Nitrogen digestibility[h], %	83.24	84.73	85.20	86.58	83.49	84.79	85.98	85.79	2.9
Biological value[i], %	74.15	71.69	74.19	75.52	52.25	52.25	52.27	51.78	6.1
Nitrogen retained[i], %	61.77	61.57	62.65	64.80	43.87	44.02	44.78	44.48	6.1

[a]Mcal ME/lb.
[b]Dietary energy density effect was linear (P<.01) and quadratic (P<.01).
[c]Dietary energy density effect was linear (P<.01) and quadratic (P<.01).
[d]pST effect P<.01; dietary energy density effect was linear (P<.10).
[e]pST effect P<.10; dietary energy density effect was linear (P<.01).
[f]pST effect P<.01.
[g]pST effect P<.05.
[h]Dietary energy density effect was linear (P<.01).
[i]pST effect P<.01.