Effect of Low Energy, High Fiber Diets on Digestibility Traits in Pigs Selected for Residual Feed Intake

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Summary and Implications

In this study, barrows and gilts from the Iowa State University Residual Feed Intake selection lines were fed two diets. The first, the Control diet, was corn and soybean-meal based, and was high in energy yet low in fiber content. The second, the Fiber diet, substituted in corn bran, wheat middlings, and soybean hulls, and resulted in a lower energy and higher fiber diet. These two diets were fed to pigs that had previously been selected for increased and decreased feed efficiency over the course of 8 generations based on residual feed intake. Fecal grab samples were collected from these pigs during the first and third finishing growth-phases with the objective of evaluating differences in dry matter, gross energy, nitrogen, and neutral detergent fiber digestibility between the two genetic lines and the two diets. This study observed beneficial increases in digestibility of fibrous feed components in pigs selected for increased feed efficiency.

Introduction

In 1999, the Residual Feed Intake (RFI) lines were established at Iowa State University with purebred Yorkshire pigs. In 2001, these pigs were split into two lines. In one line (Low RFI), selection began for increased feed efficiency measured as RFI and the other line was a randomly mated control line. RFI is defined as the difference between observed feed intake and expected feed intake based on growth, maintenance, and backfat. Beginning in the 6th generation, the control line was selected for decreased feed efficiency, which has been continued throughout the rest of the study and is referred to as the High RFI line. The Low RFI line is more feed efficient, eats less, has less backfat and more muscle, but grows slightly slower than the High RFI line.

In this study, pigs from the RFI lines were fed two diets that varied in energy and fiber contents. The objective was to determine if pigs differing in feed efficiency differed in their ability to digest the components of these two diets.

Materials and Methods

Pigs from the RFI lines were fed two diets (Control and Fiber) during the finishing growth-phase that differed drastically in energy and fiber contents. Three slightly different phases of feed were fed in order to meet the growth requirements of the pigs during finishing. These phase diets were fed from approximately 30-60 kg (phase 1), 60-90 kg (phase 2) and 90-118 kg (phase 3). In phase 1, the Control diet contained 2.42 Mcal Net Energy (NE) per kg feed and 9.4% Neutral Detergent Fiber (NDF) compared to 1.99 Mcal NE/kg feed and 25.9% NDF in the Fiber diet. In phase 3, the Control diet contained 2.48 Mcal NE/kg feed and 9.4% NDF compared to 2.05 Mcal NE/kg feed and 25.9% NDF in the Fiber diet. This provided the pigs with extremely different diets that had differences of 17% (phase 3) and 18% (phase 1) NE and 176% NDF. Titanium dioxide (TiO_2) was included in the feed as a digestibility marker, and both diets met NRC 1998 requirements.

Fecal grab samples were collected from 175 animals during phases 1 and 3 (Table 1). Diet and fecal samples were analyzed using bomb calorimetry and apparent total tract digestibility (ATTD) was calculated for dry matter (DM), gross energy (GE), nitrogen (N), and NDF.

Results

During phase 1, no differences in digestibility were seen for DM, GE, N, or NDF between the RFI lines when fed the Control diet. When fed the Fiber diet, a reduction in digestibility was seen for all traits in both lines compared to the Control diet. In addition, the Low RFI line had significantly higher ATTD estimates of DM, GE, and N when fed the Fiber diet compared to the High RFI line (Table 2).

During phase 3, the Low and High RFI lines had similar ATTD of DM, and GE for both diets, but both lines had significantly higher digestibility when fed the Control diet compared to the Fiber. No differences in ATTD of N were found between the RFI lines and the diets, but significant differences in ATTD of NDF were seen. When fed the Fiber diet, both lines had higher digestibility of NDF compared to the Control, and the Low RFI line digested more fiber than the High RFI line. When fed the Control diet, no line differences in ATTD of NDF were observed.

Full results are shown in Table 2.

Discussion

Digestibility decreased in pigs fed diets containing more fiber and less energy. However, selection for superior feed efficiency appears to be beneficial to pigs being fed diets containing high levels of fiber, especially during the final finishing phases.

Acknowledgments

Table 1: Sample sizes within Phase of line, diet, sex, and line by diet.

		Phase 1	Phase 3
		116	59
Line	Low RFI	58	20
	High RFI	58	39
Diet	Control	47	20
	Fiber	69	39
Sex	Barrows	61	32
	Gilts	55	27
Line*Diet	Low RFI*Control	23	6
	Low RFI*Fiber	35	14
	High RFI*Control	24	14
	High RFI*Fiber	34	25

Table 2: Apparent Total Tract Digestibility of dry matter, gross energy, neutral detergent fiber (NDF), and nitrogen (N) for growth phases 1 and 3, across RFI lines and diets.

		Apparent Total Tract Digestibility (%)												
		Low RFI				High RFI				P-values				
	Phase	Control	SE	Fiber	SE	Control	SE	Fiber	SE	Phase	Line	Diet	Line*Diet	Phase*Line*Diet
Dry Matter	1	$86.8^{a\#}$	1.2	59.4^{b*}	1.0	$86.1^{a\#}$	1.1	55.9^{c*}	1.0	0.29	0.14	<.0001	0.01	0.54
	3	78.5^{a*}	2.5	$70.4^{b\#}$	1.4	$80.6^{a\#}$	2.2	$68.1^{b\#}$	1.3					
Gross Energy	1	$85.7^{a\#}$	1.2	59.1^{b*}	1.1	$84.8^{a\#}$	1.2	54.8^{c*}	1.1	0.32	0.11	<.0001	0.00	0.43
	3	77.1^{a*}	2.7	$69.4^{b\#}$	1.5	$80.2^{a\#}$	2.3	$67.0^{b\#}$	1.4					
N	1	$82.9^{a\#}$	1.7	$62.0^{b\#}$	1.3	$81.6^{a\#}$	1.7	$55.8^{c\#}$	1.3	0.02	0.03	0.48	0.01	0.87
	3	64.7^{a*}	4.7	$62.1^{a\#}$	1.9	67.1^{a*}	4.1	$60.3^{a\#}$	1.8					
NDF	1	$49.2^{a\#}$	3.7	22.1^{b*}	3.3	$49.7^{a\#}$	3.7	18.1^{b*}	3.3	0.73	0.47	0.36	0.04	0.32
	3	19.0^{c*}	7.8	$48.0^{a\#}$	4.3	23.0^{c*}	6.6	$40.1^{b\#}$	4.1					

Different letters within a row signify significant differences at P<0.05
Different symbols within a column and trait signify significant differences at P<0.05