PROGENY RESPONSE IN LEAN TISSUE FEED CONVERSION TO SELECTION FOR POSTWEANING GAIN AMONG BOARS WITH LIMITED FEED INTAKE

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Story in Brief

Seven generations of selection have been completed in sublines of a population previously selected for postweaning ADG among animals allowed ad libitum access to feed. Selection criteria in the present study were: 1) postweaning ADG among boars allowed ad libitum feed intake (F), 2) postweaning ADG among boars limited to 83% of predicted ad libitum feed intake (L), and 3) a relaxed selection control (C). The hypothesis was that selection for ADG at a limited intake identifies those animals that partition the allotted energy to the relatively efficient deposition of lean tissue. To evaluate response to selection, approximately 24 barrows were sampled from each selection criterion and assigned either ad libitum access to feed or 83% of predicted ad libitum for the postweaning period from 80 to 230 lb. Carcass measurements of fat thickness were taken at 230 lb in the area of the first rib, last rib, last lumbar vertebra and the 10th rib. The right side of each carcass was separated into lean, fat and bone. ADG, average daily feed intake, feed efficiency, percentage of lean, percentage of fat, lean tissue gain (LTG) and lean tissue feed conversion (LTFC) were evaluated at each feeding level for each line. At ad libitum intake L barrows gained more ($P<.05$) than C barrows; F barrows consumed more ($P<.05$) feed per day and gained more ($P<.01$) than C barrows. At limited intake L barrows were more efficient ($P<.05$) than C barrows. There were no differences in percentage of lean, percentage of fat, LTG and LTFC among lines of pigs in this evaluation. Present results do not indicate a clear advantage for selection under limited intake.

(Key Words: Selection, Lean Tissue, Limited Intake, Swine.)

Introduction

In recent years consumers have become more interested in decreasing their fat intake due to health related issues. The swine industry must make changes to meet these demands. Methods must be developed that identify those animals which most efficiently convert energy intake to lean rather than to fat.

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Selection on a simple index of ADG and average backfat thickness has been effective as a method to improve the rate and composition of gain (Sather and Fredeen, 1978; Vangen, 1980; Cleveland et al., 1983). Metabolizable energy intake required per unit of edible lean was reduced by index selection (Cleveland et al., 1983). Fowler et al. (1976) suggested that an appropriate selection objective was lean tissue feed conversion and proposed ADG under restricted feeding as a selection criterion. Selection under conditions in which variation in feed consumption is removed should avoid the downward pressure on feed intake that may happen with selection for efficient lean gain. If animals are allowed similar amounts of feed relative to their body size, those that grow the fastest partition the available energy to lean versus fat.

Materials and Methods

Seven generations of selection have been completed in sublines of a population previously selected for postweaning ADG among animals allowed ad libitum access to feed. The selection criteria for the present study were 1) postweaning ADG among boars allowed ad libitum feed intake (F), 2) postweaning ADG among boars limited to 83% of predicted ad libitum feed intake (L), and 3) a relaxed selection control (C). Selection was replicated in spring and fall farrowing groups. The present evaluation of F, L and C barrows consisted of a 3 x 2 factorial arrangement in which each line was evaluated at ad libitum intake or limited intake (83% of predicted ad libitum intake).

A total of 72 barrows was used in this analysis. Barrows were sampled from the fall (n=36) and spring (n=36) farrowing groups. Within each farrowing group, 12 barrows representing all sires within each line were assigned either ad libitum or limited intake. At 80 lb, one additional barrow from each of the litters sampled was slaughtered and dissected into lean, fat, and bone to develop an equation to estimate on-test lean. The remaining littermate barrow was evaluated for ADG, average daily feed intake, feed efficiency, lean tissue gain (LTG) and lean tissue feed conversion (LTFC) from 80 to 230 lb. Complete separation data (lean, fat and bone) from the right side of each carcass, along with carcass fat depths at the first rib ,10th rib , last rib , last lumbar vertebra, average backfat depth and carcass loineye area were obtained at 230 lb. Lean tissue feed conversion (LTFC) was calculated as lean gain/feed intake. Sources of variation included in the model for each trait were line, feed intake level, replicate, the line x feed intake level interaction and two-way interactions with replicate. Least squares means for each of the two selection lines (F and L) were compared to the control line (C) using Dunnett's t-test. In the presence of a significant line x feeding level interaction, these same comparisons among lines were made at each feeding level.

Results and Discussion

Carcass Characteristics. Least squares means for carcass characteristics are presented in Table 1. There was a significant (P<.05) line x feeding level interaction for first rib fat depth. Also there was a tendency (P<.10) for a line x feeding level interaction for average fat depth. The three lines did not differ for any backfat depth at ad libitum intake, but at limited intake L barrows had less (P<.01) first rib fat and last rib fat depth than C barrows. At limited intake L barrows also had less (P<.05) 10th rib fat than C barrows. Ellis et al. (1983) reported that boars from a line selected for an index of increased ADG and decreased backfat, when evaluated at three different restricted feeding levels, deposited less total fat and less backfat than a control line. The results of the present study are at least in partial agreement; when evaluated at limited intake, pigs that have been selected to be more efficient at converting energy to lean have less fat.

There were no significant differences for loin eye area among the lines at limited intake, but when allowed ad libitum intake L barrows had less (P<.05) than C barrows. There were no differences between F, L and C barrows for percentage of lean or percentage of fat at either intake level.

Barrows allowed ad libitum access to feed were fatter (P<.05) than barrows that were limit fed. There was a tendency (P<.10) for barrows with ad libitum feed intake to have a lower percentage of lean than barrows that were limit fed. Also, barrows with ad libitum feed intake had a higher (P<.05) percentage of fat than barrows that were limit fed. Vandergrift et al. (1985) also reported that barrows allowed ad libitum access to feed were fatter and had a lower percentage of lean than barrows allowed limited intake.

While selection for ADG at limited intake generally decreased backfat at limited intake, differences between F, L and C barrows at ad libitum intake were minimal.

Growth Traits. Least squares means for growth traits are presented in Table 2. When allowed ad libitum feed intake, F barrows had greater (P<.01) ADG and consumed more (P<.05) feed per day than C barrows. Also at ad libitum intake, L barrows gained faster (P<.05) than C barrows, but had similar daily feed intake. There were no differences between lines for ADG at limited intake. The three lines did not differ for feed efficiency at ad libitum intake, but at limited intake L barrows were more (P<.05) efficient than C barrows.

In a line selected for decreased backfat and increased ADG, the selected pigs were more efficient at lean tissue growth at either ad libitum or restricted feed intake (McPhee, 1981). McPhee et al. (1988) selected for estimated weight of lean ham at the end of a postweaning test period that lasted 12 weeks at 85% of predicted ad libitum feed intake. After five generations of selection, select and control line pigs were compared at either limited (85%) or ad libitum access to feed. The selected line of pigs had a higher lean gain than the control line of pigs at either feeding level. McPhee and Trappett (1987) reported that,

Table 1. Least squares means for carcass characteristics from barrows representing fast (F), limit (L) and control (C) lines and allowed ad libitum or limited feed intake.

	Ad Libitum			Contrast[b]		Limited			Contrast[b]	
Characteristic[a]	F	L	C	F vs C	L vs C	F	L	C	F vs C	L vs C
CFRB, in.	1.69	1.72	1.69	NS	NS	1.53	1.40	1.65	NS	**
C10th, in	1.29	1.32	1.32	NS	NS	1.17	1.05	1.25	NS	*
CLRB, in	1.15	1.12	1.15	NS	NS	1.06	.91	1.08	NS	**
CLLV, in	1.33	1.25	1.30	NS	NS	1.21	1.06	1.19	NS	NS
CAFD, in	1.39	1.37	1.38	NS	NS	1.27	1.12	1.31	NS	**
CLEA, sq in	4.19	3.97	4.72	NS	*	4.07	3.97	4.50	NS	NS
LEAN %	39.2	39.3	42.3	NS	NS	40.7	42.4	43.1	NS	NS
FAT %	40.3	40.8	37.0	NS	NS	38.9	34.4	36.2	NS	NS

[a] CFRB = Carcass first rib fat depth; C10th = Carcass 10th rib fat depth; CLRB = Carcass last rib fat depth; CLLV = Carcass last lumbar vertebra fat depth; CAFD = Carcass average fat depth; CLEA = Carcass loineye area; LEAN % = Total lean/carcass weight x 100; FAT % = Total fat/carcass weight x 100.

[b] NS = not significant at P>.05; * = significant at P<.05; ** = significant at P<.01.

Table 2. Least squares means for growth traits from barrows representing fast (F), limit (L) and control (C) lines and allowed ad libitum or limited feed intake.

	Ad Libitum			Contrast[b]		Limited			Contrast[b]	
Trait[a]	F	L	C	F vs C	L vs C	F	L	C	F vs C	L vs C
ADG, lb	2.29	2.23	2.07	**	*	1.79	1.87	1.76	NS	NS
ADFI, lb	7.53	7.30	7.10	*	NS	5.74	5.75	5.77	NS	NS
FE, feed/gain	3.30	3.28	3.44	NS	NS	3.23	3.10	3.29	NS	*
LTG, lb/day	.59	.56	.61	NS	NS	.46	.50	.50	NS	NS
LTFC, LTG/feed	.08	.08	.09	NS	NS	.08	.09	.09	NS	NS

[a] ADG = Average daily gain; ADFI = Average daily feed intake; FE = Feed efficiency; LTG = Lean tissue gain per day; LTFC = Lean tissue feed conversion = LTG/ADFI.

[b] NS = not significant at P>.05; * = significant at P<.0; ** = significant at P<.01.

in the mouse, a line selected for ADG under limited intake expressed the greatest lean tissue feed conversion regardless of whether the lines were compared at ad libitum intake or limited intake. Contrary to results in the mouse, there were no differences between barrows from the F, L, and C lines for LTG and LTFC at either feeding level.

Barrows allowed ad libitum intake had greater ADG ($P<.05$) than barrows that were limit fed. Vandergrift et al. (1985) also found that barrows at ad libitum intake had higher ADG than barrows that were limit fed. Barrows at limited intake were more efficient ($P<.05$) than barrows at ad libitum intake. Vandergrift et al. (1985) found no differences in efficiency between barrows that were allowed ad libitum intake or limit fed. Barrows allowed ad libitum intake in the present study also had greater ($P<.05$) LTG than barrows at limited intake.

When limit fed, F and L barrows had similar lean gain but F barrows may have deposited more fat. Standardizing the lean tissue samples in this study for moisture and fat percentages may reveal differences between the lines, but the present results do not indicate an advantage for selection at limited intake to improve the efficiency of lean gain. Historically, in the United States, relatively small premiums have existed for lean pigs so little interest has been directed at lean tissue growth and lean tissue feed conversion. However, the creation of a value-based buying system placing more emphasis on carcass lean will increase the importance of alternative methods of selection for lean gain and lean tissue feed conversion.

Literature Cited

Cleveland, Erik R. et al. 1983. J. Anim. Sci. 56:570.
Ellis, M. et al. 1983. Anim. Prod. 37: 253.
Fowler, V.R. et al. 1976. Anim. Prod. 23:365.
McPhee, C. P. 1981. Aust. J. Exp. Agric. Anim. Husb. 32:681.
McPhee, C.P. et al. 1988. Anim. Prod. 47:149.
McPhee, C.P. and P.C. Trappett. 1987. Theor. Appl. Genet. 73:926.
Sather, A.P. and H.T. Fredeen. 1978. Can. J. Anim. Sci. 58:285.
Vandergrift, W.L. et al. 1985. J. Anim. Sci. 61:1454.
Vangen, O. 1980. Acta Agr. Scand. 29:305.