Protein Requirements for the Young Growing Boar

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Story in Brief

Five trials, involving 432 growing boars, were conducted to study the effects of six levels of crude protein on average daily gain, feed efficiency, average daily feed intake, average backfat thickness and average *longissimus* muscle area. Boars were self-fed either a 14, 16, 18, 20, 22 or 24 percent crude protein ration from approximately 48 to 120 lb (Period 1). Crude protein was reduced 2 percent as pens of boars reached an average weight of 120 lb.

In Period 1 (48-120 lb), average daily gain was highest in boars fed a 20 percent protein ration and maximum feed efficiency was observed in boars fed a 22 percent protein ration. Feeding either higher or lower protein levels resulted in a reduction in both average daily gain and feed efficiency (significant quadratic response $P<.0005$ and $P<.01$, respectively).

In Period 2 (120 to 220 lb), protein level did not significantly affect rate of gain, feed efficiency or average daily feed intake.

For the entire feeding period, maximum average daily gain and *longissimus* muscle area was observed in boars fed a 20 percent ration during Period 1 and an 18 percent protein ration during Period 2. Both gain and *longissimus* muscle area was reduced at either higher or lower protein levels (significant quadratic effect $P<.003$ and $P<.0001$, respectively). Efficiency of gain improved and backfat thickness decreased as dietary protein increased (significant linear effect, $P<.0001$ and $P<.001$, respectively).

The results of this study indicated that small improvements in average daily gain, feed efficiency, loin eye area and backfat thickness can be made. This can be done by feeding protein levels to growing boars approximately 2 percent higher than the currently recommended 18 percent protein ration during the growing period (48 to 120 lb). Follow by feeding a 16 percent protein ration during the finishing period (120 to 220 lb). It is doubtful, however, that the amount of improvement is adequate to offset the economic disadvantages of a more expensive ration.

Introduction

Information concerning the protein requirement of the growing boar is somewhat limited. Most recommendations are made assuming that boars require a higher level of protein supplementation than barrows or gilts because of the higher lean to fat ratio in growing boars. Although several studies have been conducted recently with growing boars suggesting that the protein requirement is higher than that for barrows or gilts,

Table 1. Composition of experimental rations.

	Level of protein						
	Treatments[a]						
	1	2	3	4	5	6	
Ingredient (%)	12% CP	14% CP	16% CP	18% CP	20% CP	22% CP	24% CP
Yellow corn	83.14	75.0	69.5	64.0	58.3	52.8	47.25
Soybean meal (44%)	8.31	16.5	22.1	27.75	33.5	39.1	44.75
Wet molasses	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Salt	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Dicalcium phosphate	1.8	1.75	1.65	1.5	1.4	1.3	1.2
Calcium carbonate	0.7	0.7	0.7	0.7	0.75	0.75	0.75
Vitamins-T.M. mix[b]	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Aureomycin 50	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
% crude protein, cal.	12.0	14.03	15.99	17.99	20.02	22.00	24.00
% calcium, cal.	0.71	0.71	0.71	0.69	0.69	0.71	0.70
% phosphorus, cal.	0.61	0.61	0.61	0.61	0.61	0.61	0.61
% lysine, cal.	0.37	0.59	0.73	0.92	1.07	1.15	1.29

[a]Two rations under each treatment indicate protein levels fed during Periods 1 and 2. The higher protein level was fed from 48 to 120 lb (Period 1) followed by a 2% reduction in protein from 120 to 220 lb (Period 2).

[b]Supplied 3,000,000 I.U. vitamin A, 3,000,000 I.U. vitamin D, 4 gm riboflavin, 20 gm pantothenic acid, 30 gm. niacin, 1,000 gm choline chloride, 15 mg vitamin B_{12}, 6,000 I.U. vitamin E, 20 gm. menadione, 0.2 gm iodine, 90 gm iron, 20 gm manganese, 10 gm copper and 90 gm zinc per ton of feed.

the results of these trials have been inconsistent and the requirement for growing boars has not been sufficiently established.

A series of trials involving a large number of boars was initiated in 1975 at Oklahoma State University and continued through 1978 to establish the crude protein levels in growing boars (48 to 220 lb) which would maximize gain, feed efficiency and muscle development.

Experimental Procedure

Five trials were conducted with a total of 432 Duroc, Hampshire and Yorkshire boars. In Trials 1, 2 and 3, 108 boars were allotted to three treatments and 54 boars were allotted to three treatments during Trials 4 and 5. During the first period of each trial (48 to 120 lb), the boars were fed either a 16, 18 or 20 percent crude protein ration (Trials 1 and 2); 14, 16, 18 percent crude protein ration (Trial 3); 18, 20 or 22 percent crude protein ration (Trial 4); or a 20, 22 or 24 percent crude protein ration (Trial 5). In the second period (120 to 220 lb), the protein level of each diet was reduced 2 percent. The composition of each ration is shown in Table 1.

The boars were allotted to treatments as they reached eight weeks of age. The allotment on any day included 27 boars with an equal number of boars from each of the three breed groups. Assignment to pens was done randomly within breed and litter. This group of boars constituted one block, consisting of three pens with an equal

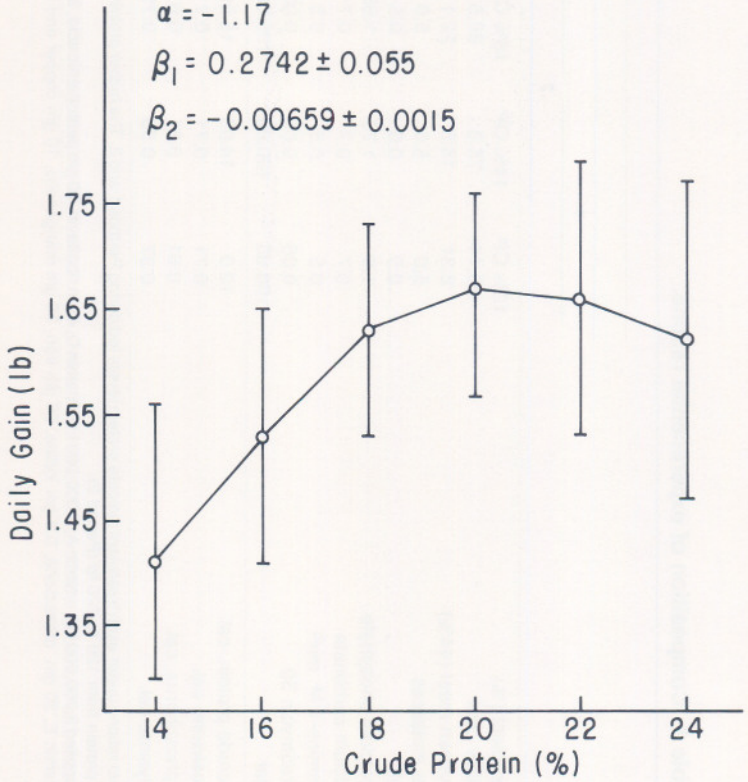

Figure 1. Average daily gain - Period 1.

number of boars of the three breed groups, for each individual trial. Trial 1, 2 and 3 contained four blocks each while Trials 4 and 5 contained two blocks.

The feeding floor was an open-front concrete finishing floor equipped with a self-feeder and automatic waterer. After assignment of nine boars per pen, the boars were given a one-week adjustment period after which on-test weights were recorded.

Protein levels in the ration were reduced for each pen individually as the boars in the pen averaged 120 lb, and boars were individually removed from test weekly as they reached 220 lb. Ultrasonic estimates of backfat thickness and *longissimus* muscle area were obtained by the use of an Ithaco Scanogram Model 721 instrument, and the measurements were adjusted to a 220 lb equivalent. Adjustments used were ± .015 sq in for *longissimus* muscle area for each lb below or above 220 lb.

To determine the average change in growth of these boars as the level of crude protein increased in two percent increments (14 to 24 percent), a regression analysis was performed on the combined trial data.

Results and Discussion

Period 1

During Period 1 average daily gain increased with increasing dietary protein levels to 20 percent of the diet followed by a decline in gain with increasing dietary protein (Figure 1, significant quadratic effect P<.0005). It should be noted that the improve-

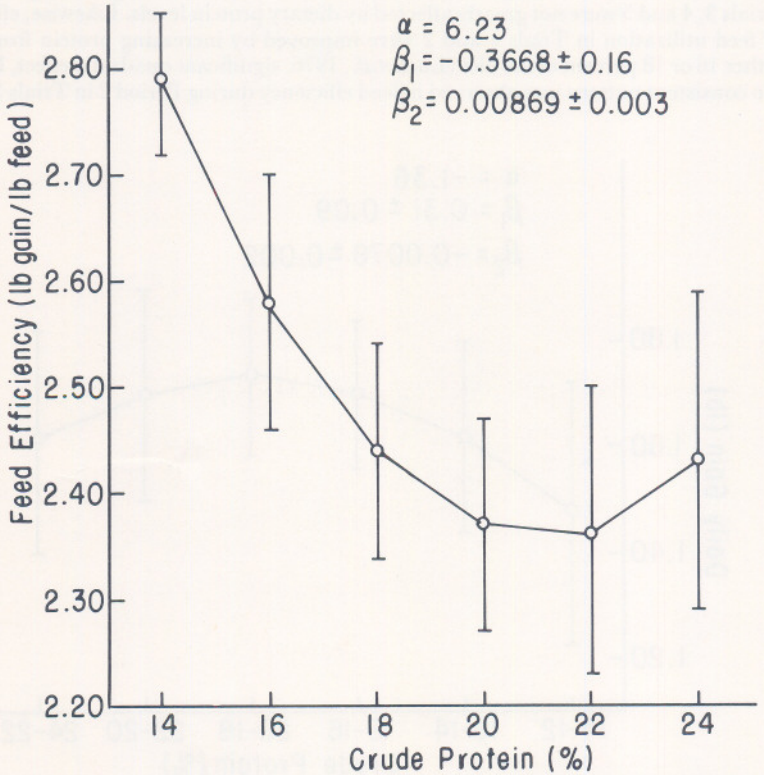

Figure 2. Feed efficiency - Period 1.

ment in gain attained by feeding protein levels above 18 percent was small (.04 lb per day increase from 18 to 20 percent protein). This data indicates that gain in young boars (48 to 120 lb) was maximized at protein levels from 18 to 20 percent. Since little improvement is noted above 18 percent protein, there appears to be little justification for feeding levels above 18 percent protein.

Efficiency of feed utilization in Period 1 reached a maximum at protein levels from 20 to 22 percent before beginning to decline at 24 percent protein (Figure 2, significant quadratic effect, $P<.01$). The amount of improvement in feed efficiency, however, at protein levels above 18 percent crude protein was small (0.17 lb feed/lb gain in going from 18 to 20 percent protein). From a practical standpoint the standard recommendation of an 18 percent crude protein corn-soybean meal ration for growing boars is very close to protein levels which maximize feed efficiency.

Although there appeared to be a slight reduction in feed intake at both the high and low protein levels, these differences were not significant in any of the individual trials or in the analysis of the combined trials.

Period 2

Protein level in the analysis of the combined trials did not significantly affect rate of gain, feed efficiency or average daily feed intake in boars from 120 to 220 lb. However, in analysis of Trials 1 and 2 average daily gain increased with increasing protein (Luce *et al.*, 1976, significant linear effect $P<.01$), but average daily gain during Trials 3, 4 and 5 were not greatly affected by dietary protein levels. Likewise, efficiency of feed utilization in Trials 1 and 2 were improved by increasing protein from 14 to either 16 or 18 percent of the diet (Luce *et al.*, 1976, significant quadratic effect, $P<.01$). No consistent pattern was observed in feed efficiency during Period 2 in Trials 3, 4 and 5.

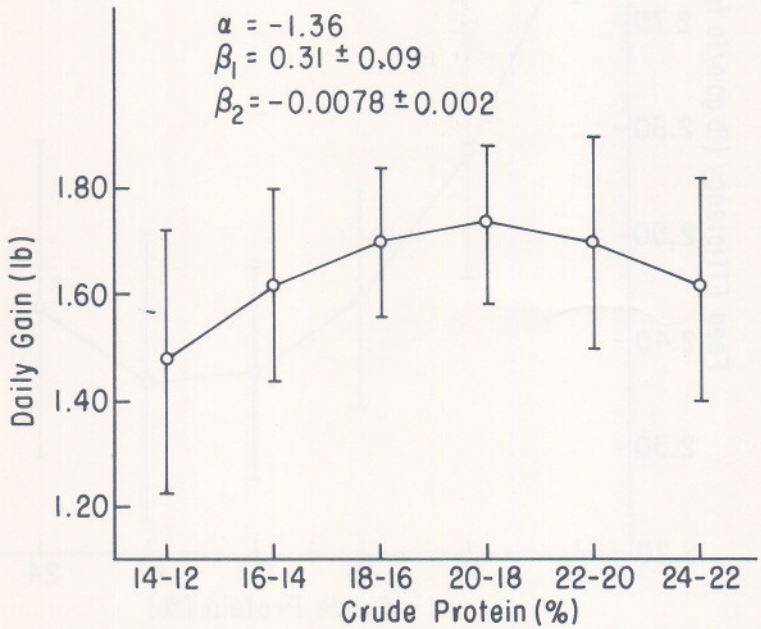

Figure 3. Average daily gain - total trial period.

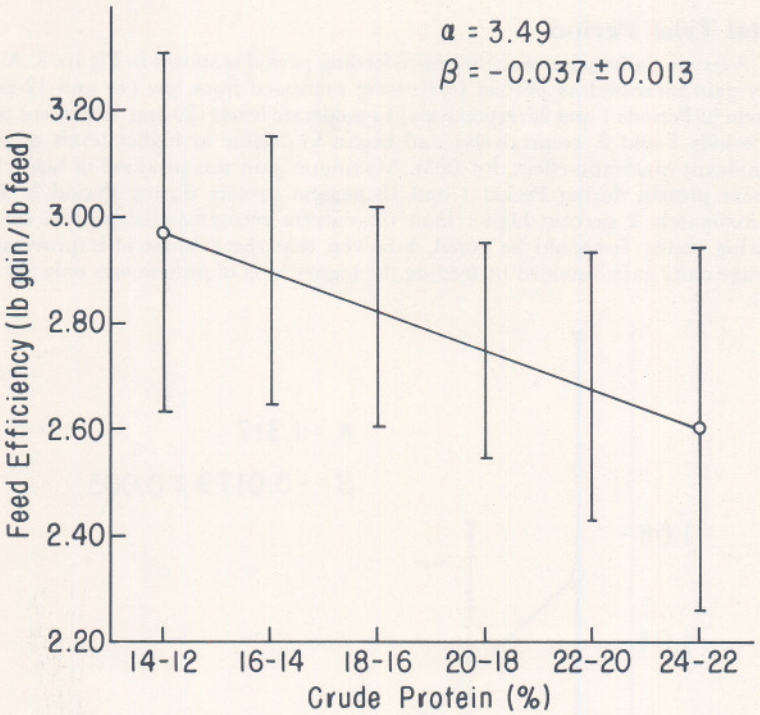

Figure 4. Feed efficiency - total trial period.

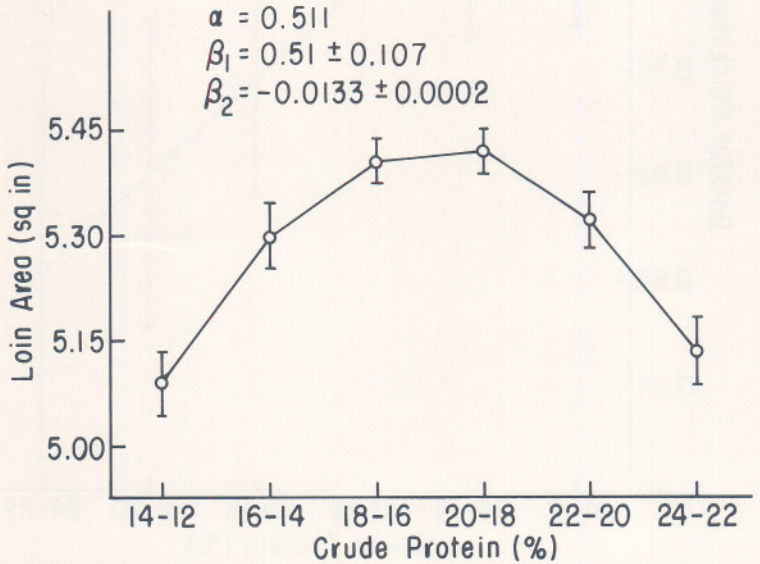

Figure 5. Longissimus dorsi muscle area - adjusted to 220 lb.

Total Trial Period

Average daily gains over the entire feeding period is shown in Figure 3. Average daily gain increased as protein levels were increased from low (14 and 12 percent protein in Periods 1 and 2, respectively) to moderate levels (20 and 18 percent protein in Periods 1 and 2, respectively) and began to decline at higher levels of protein (significant quadratic effect, $P<.003$). Maximum gain was attained in boars fed 20 percent protein during Period 1 and 18 percent protein during Period 2. This is approximately 2 percent higher than the current recommended protein levels for growing boars. It should be noted, however, that the amount of improvement in average daily gain obtained by feeding the higher level of protein was only .04 lb per day.

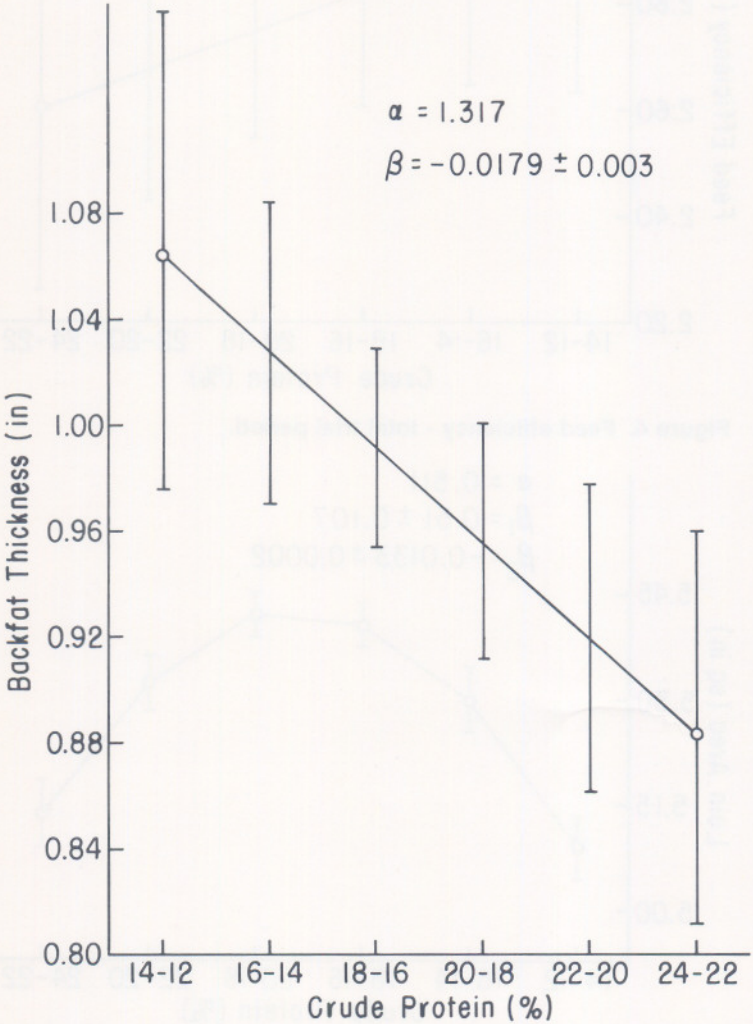

Figure 6. Backfat thickness - adjusted to 220 lb.

Efficiency of feed utilization improved in every trial (Trials 1, 2, 3, 4 and 5) as percentage of dietary protein increased, producing a linear ($P<.0001$) response to increasing protein when these trials were combined (Figure 4). This amount to a reduction in feed efficiency of approximately 0.15 lb of feed per lb of gain for every 4 percent reduction in dietary protein level. These findings are not in total agreement with Luce *et al.*, (1976) who reported a quadratic ($P<.05$) response or Spear *et al.*, (1957), and Bereskin *et al.*, (1975), who stated protein levels from 15 percent to 24 percent and 14 percent to 20 percent, respectively, have little effect on feed efficiency. However, Hale (1967), reported reduced feed required per unit weight gain as protein was increased.

Average daily feed intake tended to increase as growing boars (approximately 48 to 220 lb) were fed increasing levels of crude protein, from 14 percent to 20 percent and decreased as protein level increased to 22 and 24 percent. This trend was not significant (quadratic effect, $P<.23$) but the tendency for an increasing average daily feed intake through the 20 percent protein level is in agreement with results published by other workers (Bereskin *et al.*, 1975 and Luce *et al.*, 1976).

Longissimus muscle area (Figure 5) increased as protein was increased from low (14 and 12 percent protein during periods 1 and 2, respectively) to moderate protein levels (20 and 18 percent protein during Period 1 and 2, respectively) and decreased in pigs fed higher levels of protein (significant quadratic effect ($P<.0001$). It should be noted that protein levels which maximize gain in the total trial period and gain and efficiency in Period 1 correspond very closely with protein levels which produced maximum *longissimus* muscle area.

Backfat thickness (Figure 6) decreased as level of protein increased (significant linear effect, $P<.001$). This response although constant is not very large and a change in protein level of 2 percent only produces a reduction in backfat thickness of approximately 0.04 inches of backfat. Although backfat would probably be decreased in boars fed protein levels higher than are currently recommended, this advantage would probably not offset the disadvantages of a decreased rate of gain or a reduction in *longissimus* muscle area.

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