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Effect of Protein Consumption by the Growing Gilt Upon Puberty, Ovulation and Reproduction

G. W. Libal
South Dakota State University

R. C. Wahlstrom

South Dakota State University
Brookings, South Dakota
Department of Animal Science
Agricultural Experiment Station

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Low protein diets have been shown to significantly decrease daily weight gain of the growing pig, resulting in the pig reaching market weight at a later age. At the same time body weight has been credited with influencing the age at which gilts reach puberty and exhibit their first estrus. If replacement gilts could be fed a low protein diet during the growing period resulting in a smaller more practical sow without affecting puberty or subsequent reproductive performance, feed costs could be significantly reduced. The experiment reported herein was designed to determine the effect of a 14% protein diet and a 10% protein diet from 100 lb. to farrowing on weight gain, puberty and reproductive performance of gilts.

Experimental Procedure

Forty gilts were allotted on the basis of weight and ancestry to two replications of two treatments forming four groups each consisting of ten gilts. Average initial weight for each pen was approximately 96.7 pounds. Each gilt was fed in an individual, divided feeding stall allowing close control of feed consumption. The two experimental diets were a 10% protein diet and a 14% protein diet each fed at the rate of 4.5 lb. per day. Percent composition of the diets is shown in table 1. Stabilized animal fat was added to the higher protein diet to make the two experimental diets isocaloric.

Individual pig weights were obtained for the first 140 days to study the growth curve of the gilts receiving the two protein levels. At approximately 150 days on test blood samples were taken from each gilt to obtain blood urea nitrogen, globulin and serum protein levels as an indication of adequacy of diet. From approximately 5 months of age the gilts were checked daily with the use of a boar to detect estrus. All gilts were bred when they exhibited their third estrus regardless of age or weight. At this time weight and age at breeding were recorded. After breeding, half of those previously on the 10% diet were transferred to the 14% diet and half of the gilts receiving the 14% protein diet were transferred to the 10% protein diet. The other half of each group remained on the same diet as they received during the growing period. Half of the gilts in each of these four groups were then assigned to be slaughtered 25 days post-breeding and half were assigned to farrow. The allotment of gilts throughout the study is shown in table 2. Gilts that were assigned to the slaughter group were killed in the SDSU Meat Laboratory. Blood samples were obtained, corpora lutea on the ovaries were counted as an indication of ovulation rate and the number of embryos present in the uterus of pregnant gilts was recorded.

The gilts allotted to the farrow group were brought into the farrowing barn at 110 days of gestation, weighed and a blood sample obtained. Pig birth weight, litter weight and litter size were recorded at birth, 7 days, 14 days and 21 days of lactation. Sow weights were recorded at the same intervals. From these data, gestation weight gain and sow weight change during lactation were calculated.

Results

Table 3 indicates the growth performance of the gilts during the growing period. The gilts averaged approximately 99.7 lb. when the test started. After 28 days on test the gilts fed the 14% protein diet were significantly heavier than those receiving the 10% protein diet. This difference became greater at each 28-day weighing period throughout the first 140 days when regular weighing was terminated. Weight at breeding was not significantly different between the two groups and the difference in average weight at this time was less than at 140 days on test. Weight gain from the beginning of the trial until breeding was significantly greater for the gilts receiving the high protein diet, even though they were 5 days younger on the average than the gilts receiving the 10% protein diet.

Table 4 shows the influence of protein level fed during the growing period and the first 25 days of gestation. Weight of the gilts 25 days after breeding was significantly affected by protein levels during the grower period but not during the gestation period. Gain from breeding to slaughter and number of corpora lutea and number of embryos present in the uterus were not affected by grower or gestation protein levels.

Table 5 summarizes the effect of the grower and gestation treatments on litter size and pig performance. There was an advantage in litter size of almost 3 pigs at birth, 7 days, 14 days and 21 days for gilts fed the 14% protein diet. However, these differences were not statistically different probably due to the small number of gilts involved. Litter size was very similar when evaluated on the basis of gestation protein level. Total litter weight was greater at all weigh periods for the gilts fed 14% protein during the growing period but not significantly different. The same was true for gilts fed the 14% protein diet during gestation. Average pig weight was less for gilts fed 14% protein during the growing period. This difference was statistically significant only at birth. The lower average pig weight can probably be explained by the larger litter size of the gilts on this treatment.

Sow weight change due to protein levels is summarized in table 6. No significant differences in gestation 110-day weight, gestation weight gain, or sow weight change after 7, 14 or 21 days of lactation were observed. There was, however, a great deal of variation in average values as shown in the table.

A summary of blood data obtained from samples taken after approximately 150 days on test and either at slaughter or at parturition is shown in table 7. Total serum protein was significantly greater in samples from gilts receiving the higher protein level during the growing period after 150 days of the experiment. Other criteria at 150 days and blood urea nitrogen, globulin, total serum protein and alpha gamma globulin ratio at slaughter and parturition were unaffected by dietary protein levels.

Summary

Forty gilts averaging 99.7 lb. were allotted to two dietary treatments, 14% protein or 10% protein fed at the rate of 4.5 lb. per day. Estrus was observed with the use of a boar and all gilts were bred when they exhibited their third estrus. Gilts then either remained on the same treatment or were switched to the other treatment. Half of each group were slaughtered 25 days after breeding and the other half allowed to farrow. Gilts receiving the 14% diet were significantly heavier at 140 days on test, at breeding and at slaughter 25 days after breeding due to the dietary protein levels fed during the grower period. Gain from breeding to slaughter and number of corpora lutea and embryos were unaffected by grower or gestation protein levels. Litter size was larger at birth, 7 days, 14 days and 21 days for gilts receiving 14% protein during the growing period but not significantly different. Average pig weight was slightly less for this treatment group, probably due to the larger litter size.

Gestation weight gain and sow weight change during lactation were not significantly affected by protein levels. Blood criteria revealed a significantly higher serum protein level for gilts receiving the 14% diet after the growing period but no differences in the later sample.

Table 1. Percent Composition of Experimental Diets

	10% protein	14% protein
Ground yellow corn	93.1	81.9
Soybean meal (48.5%)	--	13.8
Soybean meal (45.0%)	3.6	--
Stabilized animal fat	--	1.1
Dicalcium phosphate	1.6	1.5
Limestone	0.5	0.5
Trace mineralized salt (high zinc)	0.5	0.5
Vitamin premix	0.7	0.7

Table 2. Allotment of Gilts for the Protein Study

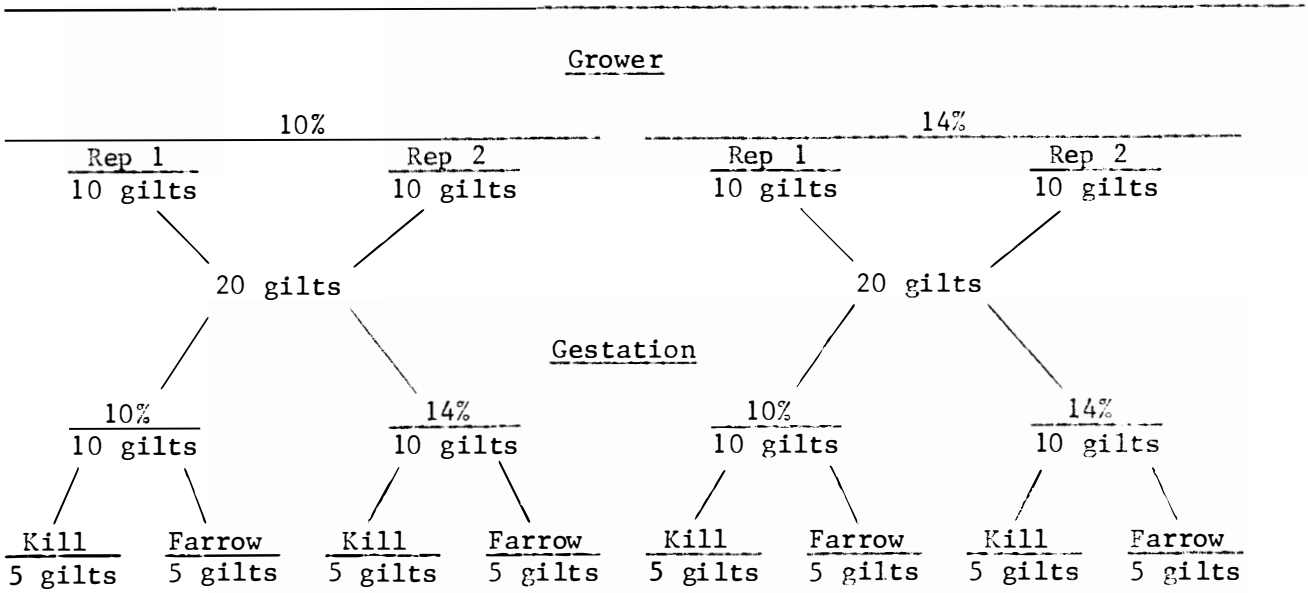

Table 3. Gilt Performance During Growing Period

	Dietary protein levels	
	10%	14%
Initial weight, lb.	99.7	99.6
28-day weight, lb.[a]	127.2	136.7
56-day weight, lb.[a]	153.5	173.2
84-day weight, lb.[a]	180.9	208.1
112-day weight, lb.[a]	208.5	241.7
140-day weight, lb.[a]	230.9	268.7
Weight at breeding, lb.	259.2	273.4
Gain to breeding, lb.[b]	157.8	174.0
Age at breeding, days	274.4	269.5

[a]Significant (P<.005) difference due to treatment.
[b]Significant (P<.05) difference due to treatment.

Table 4. Effect of Protein Levels During the Growing Period and First 25 Days of Gestation

Protein level	Grower		Gestation		Combination			
	10%	14%	10%	14%	10-10	10-14	14-10	14-14
Slaughter weight, lb.[a]	264.8	296.1	279.7	281.2	257.5	272.0	301.8	290.4
Gain to slaughter, lb.	20.8	27.7	24.2	24.3	21.0	20.5	27.4	28.0
Number of corpora lutea	13.1	14.9	13.7	14.3	12.4	13.8	15.0	14.8
Number of embryos	11.5	11.2	11.9	10.8	11.2	11.8	12.7	9.8

[a]Significant ($P<.05$) difference in slaughter weight due to protein level during the growing period.

Table 5. Effect of Gilt Protein Levels on Litter Size and Pig Performance

	Grower		Gestation		Combination			
	10%	14%	10%	14%	10-10	10-14	14-10	14-14
Birth								
Litter size	8.5	11.3	9.5	10.3	7.5	9.5	11.5	11.0
Stillborn	0.33	0.75	0.71	0.38	0.67	0.00	0.75	0.75
Litter weight, lb.	26.5	28.9	25.4	29.0	21.4	29.8	29.5	28.4
Avg. pig weight, lb.[a]	3.0	2.6	2.8	2.9	2.9	3.1	2.6	2.6
7 days								
Litter size	6.1	9.0	7.7	7.4	5.8	6.3	9.5	8.5
Litter weight, lb.	32.2	42.3	35.7	38.8	29.4	34.9	42.1	42.6
Avg. pig weight, lb.	5.3	4.9	4.8	5.4	5.1	5.5	4.5	5.3
14 days								
Litter size	6.0	8.8	7.3	7.4	5.6	6.3	9.0	8.6
Litter weight, lb.	48.6	64.4	50.4	62.6	41.6	55.7	59.3	69.4
Avg. pig weight, lb.	8.1	7.6	7.0	8.7	7.4	8.8	6.7	8.5
21 days								
Litter size	5.9	8.8	7.2	7.4	5.4	6.3	9.0	8.5
Litter weight, lb.	71.1	90.8	74.1	87.8	64.1	78.0	84.0	97.7
Avg. pig weight, lb.	11.4	10.8	10.0	12.2	10.5	12.3	9.4	12.1

[a]Significant ($P<.05$) difference due to protein level during the growing period.

Table 6. Sow Weight Change Due to Protein Levels

	Grower		Gestation		Combination			
	10%	14%	10%	14%	10-10	10-14	14-10	14-14
Gestation 110-day weight, lb.	362.2	379.4	352.0	389.6	346.4	378.0	357.0	401.3
Gestation gain, lb.	114.3	90.4	91.0	113.8	129.0	99.7	123.3	57.5
Lactation								
7-day weight change, lb.	23.7	30.0	27.3	26.8	19.8	27.5	34.8	25.3
14-day weight change, lb.	30.3	26.9	30.5	26.6	27.3	33.3	33.8	20.0
21-day weight change, lb.	39.0	28.0	40.6	26.4	41.3	36.8	40.0	15.9

Table 7. Effect of Protein Levels Upon Blood Components

	Grower		Gestation		Combination			
	10%	14%	10%	14%	10-10	10-14	14-10	14-14
End of growing period								
Blood urea nitrogen, mg %	7.89	7.85	7.83	7.90	7.66	8.11	7.99	7.70
Globulin, g %	2.90	3.07	2.84	3.13	2.51	3.29	3.18	2.95
Total serum protein, g %[a]	5.92	6.47	6.05	6.34	5.66	6.18	6.45	6.50
Alpha gamma globulin ratio	1.91	2.07	2.22	1.75	2.48	1.33	1.97	2.17
Before slaughtering or farrowing								
Blood urea nitrogen, mg %	5.53	6.60	5.68	6.46	6.06	5.00	5.29	7.92
Globulin, g %	2.54	2.72	2.61	2.64	2.56	2.52	2.69	2.77
Total serum protein, g %	6.26	6.61	6.44	6.44	6.13	6.40	6.75	6.48
Alpha gamma globulin ratio	1.53	1.48	1.54	1.47	1.46	1.60	1.62	1.34

[a]Significant ($P<.05$) difference due to protein level during growing period.