Protein and Choline Levels of Gestating Gilts

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Story in Brief

The effect of protein level and choline supplementation on weight gain, conception rate and subsequent reproductive performance was evaluated in a total of 214 gilts in the 1976 fall and 1977 spring farrowing seasons. The gilts were fed either a 12 or 16 percent crude protein ration containing either a high supplemental choline level or no supplemental choline.

Conception rate was not influenced by either protein or choline level. Gilts fed the higher protein level tended to be heavier at breeding and at 110 days of gestation.

Although not significant, litter size was consistently larger in gilts fed the higher level of protein or choline. These differences at 21 and 42 days ranged from 0.42 to 0.50 pigs per litter.

Differences in pig birth weight and litter birth weight due to protein approached significance although the differences were small. By 42 days, the litters from gilts fed 16 percent crude protein were 12.4 lb heavier than litters from gilts fed 12 percent crude protein and litters from gilts fed the higher choline were 13.1 lb heavier than litters from gilts fed no supplemental choline.

Introduction

Several recent studies have shown that supplemental choline in the diet of gestating sows fed corn-soybean meal diets results in an increase in litter size and conception rate. Since milo contains more choline than corn, it is possible that choline supplementation may not be as critical in sows fed milo based diets.

Studies in the growing pig indicate that the dietary requirement of choline can be replaced by high levels of dietary methionine or protein. The effect of protein on the choline response observed in gestating sows has not been studied.

This study was conducted to evaluate the effect of dietary protein and choline in gilts fed a milo-soybean meal based diet during gestation on weight gain, conception rate and subsequent reproductive performance.

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Table 1. Composition of experimental rations

Ingredients	12% CP 0 choline	12% CP + choline	16% CP 0 choline	16% CP + choline
Milo	86.31	86.31	75.17	75.17
Soybean meal (44%)	10.02	10.02	21.32	21.32
Dicalcium phosphate	1.66	1.66	1.42	1.42
Calcium carbonate	1.01	1.01	1.09	1.09
Salt	0.50	0.50	0.50	0.50
Vit T.M. premix[a]	0.50	0.50	0.50	0.50
Auro SP-250[b]	+	+	+	+
Total	100.00	100.00	100.00	100.00
% crude protein calculated	12.0	12.0	16.0	16.0
Mg/lb supp choline 1976-Fall	0	0	400	400
Mg/lb supp choline 1977-Spring	0	0	250	250
% calcium, calculated	0.75	0.75	0.75	0.75
% phosphorus, calculated	0.60	0.60	0.60	0.60

[a]Supplied in addition to choline 3,000,000 IU Vitamin A, 300,000 I.U. Vitamin D, 4 gm riboflavin, 20 gm pantothentic acid, 30 gm niacin, 15 mg Vitamin B_{12}, 6,000 IU Vitamin E, 2 gm menadione sodium bisulfite, 0.2 gm iodine, 90 gm iron, 20 gm manganese, 10 gm copper and 90 gm zinc per ton of feed.
[b]ASP-250 was provided at the rate of 5 lb/ton in all rations throughout the experiment.

Experimental Procedure

This study was conducted at the Southwestern Livestock and Forage Research Station swine facilities in the 1976 fall and 1977 spring farrowing seasons. A total of 214 gilts were randomly allotted from within breed group to four treatments consisting of two levels of protein (12 percent and 16 percent; Table 1) and two levels of choline (0 supplemental choline and 400 mg/lb supplemental choline in 1976 fall and 250 mg/lb supplemental choline in 1977 spring) in a 2 × 2 factorial experiment. Gilts were maintained in dirt lots and were group fed approximately 4.5 lb/head/day. The gilts were fed a 16 percent crude protein milo-soybean meal diet with adequate choline prior to the initiation of the trial.

Breeding was started within one week after the trial was initiated in both breeding seasons. Gilts were checked daily for estrus and were hand mated on two consecutive days to the same boar. A two month breeding season began June 1 for the fall farrowing and December 1 for the spring farrowing.

At day 110 of pregnancy, gilts were moved to individual farrowing stalls and litters were penned separately until weaned at 42 days. Beginning on day 110 of gestation all gilts from all treatment groups were fed a 16 percent crude protein lactation diet with 250 mg/lb of supplemental choline throughout lactation. Therefore, any effects on lactation were carry-over effects from the diet during gestation.

Table 2. The effect of dietary protein and choline level on conception rate and weight gain of gilts

Protein level	12% Protein		16% Protein		Sig.
Choline level	0 choline	+ choline	0 choline	+ choline	Level
No. gilts	54	55	55	50	
1st serv conc rate[a]	70.4	67.3	74.5	70.0	NS
Conc rate[b]	83.3	89.1	89.1	90.0	NS
Breeding wt	272.3	280.5	291.7	282.7	Prot., P<.07
110-day wt	367.8	371.9	394.1	377.4	Prot. P<.05
Gestation gain	95.5	91.5	102.2	94.8	NS
Weaning wt	366.2	358.4	380.4	367.3	NS
Lact gain	0.1	−12.9	−13.8	−9.5	NS

[a]Percentage of gilts which farrowed a litter after one mating period.
[b]Percentage of gilts which farrowed a litter of pigs.

Results and Discussion

The effect of choline and protein level fed during gestation on conception rate and gilt weight changes are listed in Table 2. No significant differences were observed in either first service conception rate or overall conception rate. Other workers (Stockland and Blaylock, 1974) have observed a decrease in conception rate in gilts fed a corn-soy diet with no supplemental choline. In their studies, however, the low choline diet was started 6 to 8 weeks prior to the initiation of breeding.

Gilts fed the 16 percent protein diet were approximately 10 lb heavier at breeding (P<.07) and 15 lb heavier at 110 days of gestation (P<.05) than gilts fed the 12 percent protein diet. However, no significant differences were observed in the weight of gilts at weaning or in gestation and lactation weight changes. The low level of protein fed prior to breeding and during gestation may not have supported maximum gain.

Choline had no significant effect on gilt weight during either gestation or lactation. This suggests that choline is not needed to attain maximum weight gain in gestating gilts. Since supplemental choline is not required for maximum gain in growing and finishing hogs, no beneficial effect on weight gain in gilts was expected.

Although differences in number of live pigs born, number at 21 days, number at 42 days and survival rate were not significantly affected by either dietary protein or choline, it should be noted that litter size at each of these time periods was larger in gilts fed the higher level of protein or choline (Table 3). The increase in litter size at 3 weeks of age in gilts fed supplemental choline during gestation in this study is similar to the increase observed by the NCR-42 committee on swine nutrition (0.50 pigs per litter, NCR-42 commit-

Table 3. The effect of choline and protein level during gestation upon subsequent litter size and survival rate

	12% Protein		16% Protein		Sig.
	0 choline	+ choline	0 choline	+ choline	Level
No. pigs[a]	10.36	10.78	10.94	10.60	NS
No. 21 days	7.40	8.08	8.12	8.36	NS
No. 42 days	7.16	7.81	7.87	8.06	NS
Survival rate, %	68.70	72.97	72.78	76.14	NS

[a]Number of fully formed pigs.

Table 4. The effect of protein and choline level during gestation on subsequent pig birth weight and gain

	12% Protein		16% Protein		Sig.
	0 choline	+ choline	0 choline	+ choline	Level
Pig birth wt, lb	2.75	2.76	2.75	2.81	Prot., P<.06
Litter birth wt, lb	28.1	29.2	30.0	29.6	Prot., P<.08
Pig 21-day wt, lb	10.3	10.6	10.3	10.6	NS
Litter 21-day wt, lb	76.5	86.1	84.6	88.9	NS
Pig 42-day wt, lb	21.7	22.1	22.0	22.6	NS
Litter 42-day wt, lb	155.5	172.5	171.8	180.9	Prot., P<.04 Chol., P<.07

tee on swine nutrition, 1976). Litter size at both 21 and 42 days was also higher (0.50 and 0.48 pigs per litter, respectively) in gilts fed the 16 percent protein gestation diet than in gilts fed the 12 percent protein diet. Survival rate ranged from a low of 68.7 percent in pigs from gilts fed both low protein and no supplemental choline to a high of 76.14 percent for pigs from gilts fed the high protein diet with supplemental choline.

The effect of protein and choline level during gestation on subsequent pig birth weight and gain are shown in Table 4. Although differences are small, feeding a higher protein diet during gestation increased pig birth weight ($P<.06$) and litter birth weight ($P<.08$). This trend for increased litter weight in pigs from gilts fed the higher level of protein during gestation was observed at both 21 and 42 days (5.45 and 12.4 lb/litter heavier, respectively) although differences were significant only at 42 days. Differences in pig weight at 21 and 42 days were not significant.

Litters from gilts fed the supplemental choline during gestation were 13.1 lb heavier ($P<.07$) at 42 days than litters from gilts with no supplemental choline. This overall effect is due to both a slight increase in survival rate and pig weight. The data from this trial suggest that supplemental choline and a level of protein higher than a 12 percent crude protein milo-soybean meal diet during gestation are essential in order to maintain maximum reproductive performance.

Table 5. The effect of protein and choline level during gestation on the spraddle leg condition in newborn pigs

	12% Protein		16% Protein	
	0 Choline	+ choline	0 choline	+ choline
No. gilts farrowing	45	49	49	45
No. gilts with one or more spraddle leg pigs	5	7	3	3
No. live pigs farrowed with spraddle legs	6	7	5	5

The incidence of spraddled leg pigs was very low in all treatments (Table 5). No differences in the number of sows farrowing pigs with spraddle legs or number of pigs with spraddle legs due to level of choline or level of protein were observed. One or more spraddled leg pigs was observed in 8.5 percent of the litters from sows fed 0 supplemental choline and 10.6 percent of the litters from sows fed supplemental choline.

Literature Cited

NCR-42 Committee on Swine Nutrition. 1976. Effect of supplemental choline on reproductive performance of sows: A cooperative regional study. J. Anim. Sci. 42:1211.

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