Effect of Beta-carotene on Reproductive Performance in Swine

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Summary and Implications

Injection of beta-carotene did not alter live litter size, total born, number born dead, number of stillborn pigs, and number of mummified pigs in this study. Number of pigs weaned and litter weaning weight also were not significantly different (P>.05). Furthermore, no significant interactions between parity and beta-carotene injection were observed.

The commercial herds that were evaluated had already achieved high levels of reproductive performance. Average number of pigs born alive pretreatment was 10.51. These herds were under excellent management and the breeding herd was in superior condition. Perhaps the treatment would be more successful in situations where the sow herds have lower reproductive performance. Use of beta-carotene should be a farm by farm decision, using records to warrant and to verify the effectiveness of beta-carotene treatment.

Introduction

Vitamin A has long been known to affect reproduction in swine. Although the mechanism is not understood, it is clear that vitamin A may work at several critical sites to enhance embryonic development and survival. Vitamin A Palmitate works on uterine and ovarian cells, whereas Vitamin A Proprionate would increase liver metabolism but not influence reproductive changes.

Swine diets are routinely fortified with Vitamin A at levels above NRC recommendations. Trials at North Carolina State have shown a response in number of pigs born alive in the subsequent farrowing when sows and gilts were injected prebreeding with Vitamin A or its precursor beta-carotene. Results from these trials have shown litter size increases up to one pig born per litter. A four-station abstract reported that a Vitamin A injection at weaning and breeding improves reproductive performance by increasing the number of pigs weaned per litter. There were 10.7, 10.8, and 10.4 ± .41 pigs born alive per litter (P=.78) for sows given 250,00 IU vitamin A, 500,000 IU vitamin A, and the placebo, respectively.

In a study at the University of Missouri, it was reported that lethal levels of vitamin A may be a major reason 20 to 40% of pig embryos fail to live past the first month of the pregnancy. Vitamin A levels in the uterus of the sow increase 100 to 1000 times normal at day 11 of pregnancy, just as embryos start to elongate rapidly. Embryos that thrive on Vitamin A elongate the fastest, and ultimately survive. From this study, it seems possible that advanced embryos kill their less-advanced siblings by causing increased uterine secretion of vitamin A. The researchers indicated that this seems to be part of a natural selection process. If the rate of embryonic development can be more synchronous (embryos developing at the same rate), the embryonic mortality could probably be reduced.

Work at Kansas State University has shown little or no response to Vitamin A. Additionally, a study at Purdue University has shown that a single injection of vitamin A does not influence total litter size, live litter size, litter weight, pig weight, number of runts or number of mummies.

Beta-carotene, as a precursor to Vitamin A, needs to be evaluated for its effectiveness in improving reproduction. A field trial was conducted to determine if university research can be verified in the field in commercial herds of swine by the evaluation of the effect of beta-carotene injection on reproductive performance. Factors examined were number of pigs born, number of pigs born alive, litter weaning weight, and conception rate for primiparous and multiparous sows.

Materials and Methods

Two cooperators in Iowa were selected as herds to test the effect of beta-carotene injection on reproductive performance. Extensive records were obtained from each operation – one in eastern Iowa and the other in northwest Iowa.

Data recorded from the two commercial swine operations were sow identification, parity, previous farrowing date, pigs born alive, pigs born dead, date of weaning, date of treatment, date farrowed, number born alive, number born dead and reasons for sow culling.

Treatment consisted of beta-carotene and control placebo injection. Injections were administered post-weaning and before the sows were bred. Treatment effects on the following traits were evaluated: conception rate, number of pigs born alive, number of stillborn pigs, and number of pigs weaned.

All weaned sows were paired by number weaned and parity. A total of 167 pairs of females was included in the analysis. One member of each pair was injected with beta-carotene, and the other with a placebo (saline solution). Sows were housed, fed, and treated with normal husbandry practices for a commercial herd. Diets were formulated at or above NRC recommendations. Facilities were mostly confinement, with a majority of the sows housed inside. Post-farrowing data were collected and analyzed. The General Linear Models procedure of SAS was used to analyze the data.

Results and Discussion

Treatment consisted of beta-carotene and control placebo injection. No signs of injection site reaction were observed. Only data from breeding females settled in the first heat period were used for analysis. Control breeding females farrowed .45 more total pigs per litter, although this difference was not statistically significant. Control breeding females farrowed .17 more live born pigs and .3 more dead pigs per litter than breeding females treated with beta-carotene. These differences also were not statistically significant.

Table 1. Least squares means for the effect of prebreeding beta-carotene injection on litter size.

Traits	Beta-Carotene	Control Placebo
Total number of pigs born	10.98	11.43
Number of pigs born alive	10.02	10.19
Number of pigs born dead	.95	1.25

No statistically significant differences were found in the number of stillborn pigs and number of mummified pigs. Number of pigs weaned per litter, litter birth weight, and average adjusted 21-day litter weight also were not different. Average sow parity between the two groups was nearly the same (control = 3.71 and beta-carotene = 3.78).

Differences were measured among parity groups. In agreement with previous work, parity of the breeding female impacted reproductive performance. Total number of pigs born changed with parity (P=.037) as did number born dead (P=.007). Number of pigs born alive was not significant among parity groups. No significant interactions between parity and beta-carotene injection were found. Least squares means by parity of the dam are presented in Table 2.

Table 2. Least squares means for the effect of parity of breeding females on reproductive performance.

Parity	Number Born Alive	Total Born	Number Born Dead
1 (n=23)	9.93	10.59	.66
2 (n=103)	9.89	10.72	.84
3 (n=48)	10.41	11.42	.99
4 (n=40)	9.82	11.17	1.35
5 (n=61)	10.80	12.36	1.56
6 (n=25)	10.68	12.19	1.51
7 (n=18)	9.60	11.37	1.77
8 (n=11)	8.27	8.98	.71
9 (n=2)	11.51	12.08	.58
10 (n=3)	10.13	11.17	1.04

The effect of beta-carotene also was evaluated in 152 litters from breeding females that failed to conceive during the first heat period after treatment. These were not included in the previous reproductive performance analysis. Differences in reproductive performance between control and treatment groups were not statistically significant.

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