Effectiveness of vitamin A to increase litter size

A.E. Pusateri, M.A. Diekman, and W.L. Singleton

Department of Animal Sciences

1996 Purdue Swine Day

Materials	Results	Discussion	Applications	References	Tables

Sows ovulate 15 to 20 ova and the fertilization rate is over 90%. As a result, sows begin pregnancy with about 14 to 19 embryos. However, by farrowing, 30 to 40% of the embryos initially present have died. The pig uterus appears to be capable of carrying 12 to 14 fetuses to term. The average litter size in the United States is approximately 10, indicating that there is considerable potential for improvement in litter size.

Recent studies have suggested that litter size may be increased by up to one pig per litter in sows injected at weaning with vitamin A or beta-carotene, a compound which is converted to vitamin A in the body. It has been proposed that vitamin A may increase litter size by increasing the proportion of embryos which survive to farrowing. The mechanism by which this may be accomplished is not yet understood. The exact timing of injections required to elicit an increase in litter size is also unknown. The objectives of this study were to:

1) Determine the effectiveness of the use of vitamin A injections to increase litter size.

2) Determine the stages of gestation at which injection of vitamin A will increase litter size.

Materials and Methods

This study was conducted in a fully enclosed commercial farrowing operation located in central Indiana. The facility maintained a 1000 sow herd consisting primarily of PIC Camborough sows and gilts. Sows which returned to estrus within 10 days of weaning were bred twice daily during estrus to different boars. Sows were housed in gestation crates following breeding. Farrowing was accomplished on an all-in/all-out basis.

A total of 1375 sows were initially assigned to the study. Sows were assigned randomly to the treatment groups at the time of weaning; treatment was given at weaning, or on days 0-110 of gestation, as listed in Table 1. Injections of either 1,000,000 IU vitamin A in corn oil or corn oil alone (control) were administered intramuscularly on the day of treatment. At farrowing, total litter size, live litter size, live litter weight, number of live

runts (< 2 pounds), and gestation length were recorded. For the purposes of this study, farrowing rate was calculated as:

(number of sows farrowing/number of sows assigned at weaning) x 100%

Because sows were assigned to treatment at the time of weaning, sows which were assigned but were not bred due to failure to return to estrus within 10 days are included in the number assigned.

The effects of treatment and parity group on total litter size, live litter size, litter weight, number of runts, and gestation length were analyzed. Parity groups were defined based on the number of previous pregnancies completed, as depicted in Table 3. Farrowing rates were compared on the basis of treatment. There were no effects of day of oil injection among the control sows. Therefore, data from all control sows were combined for further analysis.

Results

There were no effects of treatment on any litter parameters measured (Table 2). Total litter size was 11.5 ± 0.1 overall. Mummies averaged 0.2 ± 0.1 per litter. Overall farrowing rate was 71.1%, with no treatment effects observed (Table 1). As shown in Table 3, parity group affected total litter size, live litter size, and litter weight ($P < .01$) but not pig weight, number of runts, number of mummies, or gestation length ($P > .1$).

Discussion

No effects of vitamin A injection on litter size or litter weight in sows were observed in this study. This is consistent with a study in which no increase in litter size was observed in gilts which were injected with vitamin A at breeding (Davis et al., 1994). Two other studies have reported increased litter sizes following treatment with vitamin A or beta-carotene. Brief and Chew (1985) reported an increased litter size in gilts which were injected with vitamin A and beta-carotene compared to those which received only dietary vitamin A and beta-carotene (9.5 versus 8.7 pigs per litter, respectively). However, the gilts in that study had been previously subjected to a vitamin A deficient diet. Therefore, the observed difference in litter size may have been dependent on a pre-existing vitamin A deficiency. Coffey and Britt (1993) reported litter size increases of 0.4 to 0.6 pigs per litter in sows injected with vitamin A or beta-carotene. The effective treatments included a single injection of sows with a sustained release form of beta-carotene at weaning or a series (approximately two weeks) of multiple vitamin A or beta-carotene injections beginning at weaning. The current study and the study by Davis et al. (1994) each used a single injection of vitamin A treatments and found no increases in litter size. It is possible that the differences in results observed in studies thus far are due to a requirement for prolonged exposure to vitamin A, either through multiple injections or use of a sustained release form of vitamin A or beta-carotene. Based on data currently available, it does not appear that a single injection of vitamin A at any time from weaning to farrowing results in increased litter size in sows.

Applications

The effectiveness of using injections of Vitamin A to increase litter size in pigs has been variable. Based on the data obtained in this study, we cannot recommend that a single injection of vitamin A at any time from weaning to farrowing would result in increased litter size in sows.

References

Brief, S. and B.P. Chew. 1985. Effects of vitamin A and b-carotene on reproductive performance in gilts. J. Anim. Sci. 60:998-1004.

Coffey, M.T. and J.H. Britt. 1993. Enhancement of sow reproductive performance by beta-carotene or vitamin A. J. Anim. Sci. 71:1198-1202.

Davis, D.L., D. Schonewels and M. Nelson. 1994. Injection of vitamin A at insemination and reproductive performance in gilts. Kansas State University Swine Day Report. pp. 4-6.

Table 1. Farrowing Rate

Treatment	Sows Assigned	Sows Farrowed	Farrowing Percent
Oil	125	92	73.6
Vit A at Weaning	125	75	60.0
Vit A Day 0[a]	125	86	68.8
Vit A Day 2	125	94	75.2
Vit A Day 6	125	92	73.6
Vit A Day 10	125	92	73.6
Vit A Day 13	125	91	72.8
Vit A Day 19	125	80	64.0
Vit A Day 30	125	94	75.2
Vit A Day 70	125	89	71.2

Vit A Day 110	125	92	71.2
Overall	1375	977	71.1

[a] Day of gestation.

Table 2. Effect of Vitamin A Injection on Reproductive Performance of Sows

Litter Size	Live Litter Size	Litter Weight (lbs)	Pig Weight (lbs)	Runts	Gestation Length (Days)
Oil	9.7±0.4	33.5±1.1	3.5±0.2	0.2±0.1	115.1±0.2
Vit A at Weaning	9.5±0.3	33.9±1.3	3.4±0.2	0.1±0.1	115.3±0.2
Vit A Day 0[a]	10.6±0.3	35.8±1.1	3.4±0.1	0.2±0.1	115.1±0.2
Vit A Day 2	9.5±0.3	32.7±1.1	3.4±0.1	0.2±0.1	115.3±0.2
Vit A Day 6	10.0±0.4	34.5±1.2	3.5±0.2	0.1±0.1	115.4±0.2
Vit A Day 10	10.0±0.3	34.8±1.0	3.6±0.1	0.1±0.1	115.2±0.2
Vit A Day 13	9.6±0.3	34.9±1.1	3.6±0.2	0.1±0.1	115.1±0.2
Vit A Day 19	9.7±0.4	34.6±1.2	3.5±0.2	0.2±0.1	115.4±0.2
Vit A Day 30	9.7±0.3	33.7±1.0	3.6±0.1	0.4±0.1	115.4±0.2
Vit A Day 70	10.2±0.4	35.1±1.1	3.8±0.2	0.2±0.1	115.0±0.2

Vit A Day 110	9.9±0.3	35.1±1.1	3.7±0.2	0.2±0.1	115.0±0.2
Overall	10.1±0.1	35.2±0.1	3.6±0.1	0.2±0.1	115.2±0.1

[a] Day of gestation.

Table 3. Effect of Parity Group on Reproductive Performance of Sows

Parity Group	Sows[a]	Total Litter Size	Live Litter Size	Litter Weight
Parity 1-2	320	11.4±0.2b	10.6±0.2b	37.0±0.5b
Parity 3-4	315	11.9±0.2b	10.6±0.2b	36.9±0.6b
Parity 5-6	180	11.8±0.3b	10.2±0.2b	34.5±0.8c
Parity > 6	155	10.3±0.3c	8.1±0.3c	29.3±0.8c

[a] Parity could not be positively determined for 7 sows, which are excluded.

[b, c, d] Means in the same column with different superscripts are significantly different ($P<.01$).