RESEARCHREPORT

ANIMAL WELFARE

Title: Effect of Prenatal Androgenization on Growth Rate, Feed Efficiency, and Carcass Quality of Swine – **NPB #98-092**

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I. Abstract:

This study was conducted to determine if the prenatal administration of testosterone, prenatal androgenization, would enhance the growth rate of pigs as has been reported in ruminants. Fifteen gilts or sows were administered testosterone via an intravaginal controlled release insert on days 21-26 of gestation. Females were confirmed pregnant via ultrasound before insert administration and inserts were left in situ for 35 days. Pregnancy was terminated in six of the 15 (40%) females administered the intravaginal testosterone insert. Although the live offspring were normal at birth and equal in weight to the non-prenatally androgenized pigs, there were fewer live offspring. Litters that had been prenatally androgenized had a higher incidence of stillborns and mummified fetuses. Therefore, prenatal androgenization, as done in this study, increased the incidence of pregnancy termination and increased embryonic and fetal mortality. Also, in contrast to our results in cattle, prenatally androgenization appeared to have no effect on the growth rate or on the gain to feed ratio.

II. Introduction:

Efficiency of growth has a profound effect on the profitability of swine and postnatal growth enhancement treatments are generally not viewed favorably by the FDA. As we have previously demonstrated, prenatal administration of testosterone, prenatal androgenization, enhances the growth rate of ruminants and preliminary data suggest that this effect may be observed in pigs, it was our objective to assess the value of prenatal androgenization in the swine industry. Although this was previously considered, there were no methods to effectively administer testosterone to swine over a prolonged period of time. Therefore, we developed an intravaginal controlled-release insert that would release testosterone over several weeks. Development of this insert made it possible to evaluate the potential of prenatal androgenization in the swine industry.

III. Objective:

The objective was to determine the efficacy of prenatal androgenization on performance of male and female offspring.

IV. Procedures:

This study was conducted at the University of Illinois Swine Research Center. Treated sows were administered an intravaginal insert that contained testosterone propionate. Inserts were administered 21-26 days after insemination. Immediately before insert administration, gilts (n=11) and sows (n=4) were examined via transrectal ultrasound to verify pregnancy. Only pregnant gilts and sows were selected for the study. Inserts were left *in situ* for 35 days. Gilts and sows were examined via transrectal ultrasonography a second time 9 days after insert administration and were bled 5, 13, 21, and 36 days after insert administration. Blood sera were assayed via a validated ELISA for testosterone concentrations. Treated gilts and sows were observed during the treatment period and around the time of parturition. External genitalia of the offspring were examined shortly after birth. Birth and post-natal weights to determine the rate of growth were also collected on the offspring. In addition, feed intake was determined during the finishing phase and used to determine feed-to-weight gain.

V. Results:

The following data are summarized in Table 1 as well.

1. Within 2-3 days after insert administration, vaginal discharges were observed in some of the treated females. Therefore, another ultrasound examination was preformed nine days after insert administration. It was discovered that six of the females had aborted (6/15=40% abortion response). A similar percentage of sows (4/11=36%) and gilts (2/4=50%) aborted.

2. Blood samples were collected from all 15 treated females on days 5 and 13 post-insert administration. Inserts from the six females that aborted were removed from the study 13 days post-insert administration. The nine females that remained pregnant were also bled on days 21 and 36 post-insert administration. On days 5 and 13, blood testosterone concentrations were not different between females that maintained pregnancy and those that aborted (Figure 1). It is unknown at this time why the females aborted in response to testosterone treatment. Abortions have not been previously observed in pigs, cattle, and sheep administered testosterone during pregnancy.

3. All inserts were recovered at the time of removal on day 13 (females that aborted) or day 35 (females that maintained pregnancy). Therefore, there was a 100% retention rate of the inserts. Therefore, the retention rate of the inserts was 100%—uncommonly high for intravaginal inserts used in other species.

4. Testosterone concentration was elevated over the 35 days period as expected and testosterone concentrations were at anticipated levels (Figure 1). Therefore, the inserts released testosterone over a sustained period of time as designed. Furthermore, minimal variation in blood testosterone concentrations was observed implying that the inserts were consistent.

5. Embryonic/fetal development was normal as all offspring delivered, including stillborn pigs, were normal in appearance. Further, external genitalia in prenatally androgenized pigs did not differ from control pigs.

6. The number of offspring, alive at birth, stillborn, and mummified fetus, sex ratio, birth weight, and post-natal growth rate are reported in Table 1. As this was a preliminary study, an insufficient number of animals were included to determine statistical differences; however, empirical differences are apparent (see Table 1).

7. The sex ratio was similar between control and prenatally androgenized litters. This would suggest that testosterone concentrations at the dose administered did not alter anatomical development as anticipated.

8. The percent of live offspring appeared to be reduced by the testosterone treatment (86% *vs.* 73%). Consistent with a decrease in the number of live offspring is an increase in the numbers of stillborn offspring and mummified fetuses. Therefore, the testosterone treatment not only appeared to terminate pregnancy in 40% of the females; the incidence of embryonic and fetal mortality was increased.

9. Birth weight was only slightly affected. Consistent with our research in cattle, there was a slight decrease in the birth weight of the female offspring; however, this change may have only occurred because of chance.

10. The post-natal growth rate and the gain to feed ratio appeared to be unaffected by prenatal androgenization, which differs from our results in ruminants. Upon further examination of the ruminant data, the boost in growth rate and feed efficiency is greatest after the prenatally androgenized females reach pubertal age. Therefore, the lack of response observed in swine may be due to the fact that they reach slaughter age before puberty. One could hypothesize that estrogens and progestins secreted by the ovaries of post-pubertal ruminants are necessary to evoke the benefit of prenatal androgenization.

Table 1. Effect of the Sustained Administration of Testosterone Propionate during Porcine Gestation on Embryonic and Fetal Mortality and Growth and Development of the Offspring

Item	**Control**	**Testosterone Treated**
Live Offspring[a]	9.38±1.09	8.44± .92
Stillborn Offspring[a]	1.25± .45	2.67± .65
Mummified Fetuses[a]	.25± .16	.44± .18
Total Number of Offspring[a,b]	10.88±1.32	11.55± .97
Live Offspring[c]	86%	73%
Sex Ratio[a,d]	.48± .10	.53± .08
Birth Weight[a] (kg):		
Female offspring	1.54± .09	1.48± .07
male offspring	1.62± .08	1.62± .09
Average Daily Gain[a] (kg):		
Female offspring	1.30± .05	1.27± .04
male offspring	1.31± .05	1.32± .04
Gain to Feed[a]:		
female offspring	.39± .02	.42± .01
male offspring	.40± .02	.38± .02

[a]Mean ± standard error
[b]Total number of offspring delivered (live, stillborn, and mummified fetuses).
[c]Live offspring divided by total number of offspring (#4) x 100.
[d]Number of live females divided by total number of live offspring (#1).

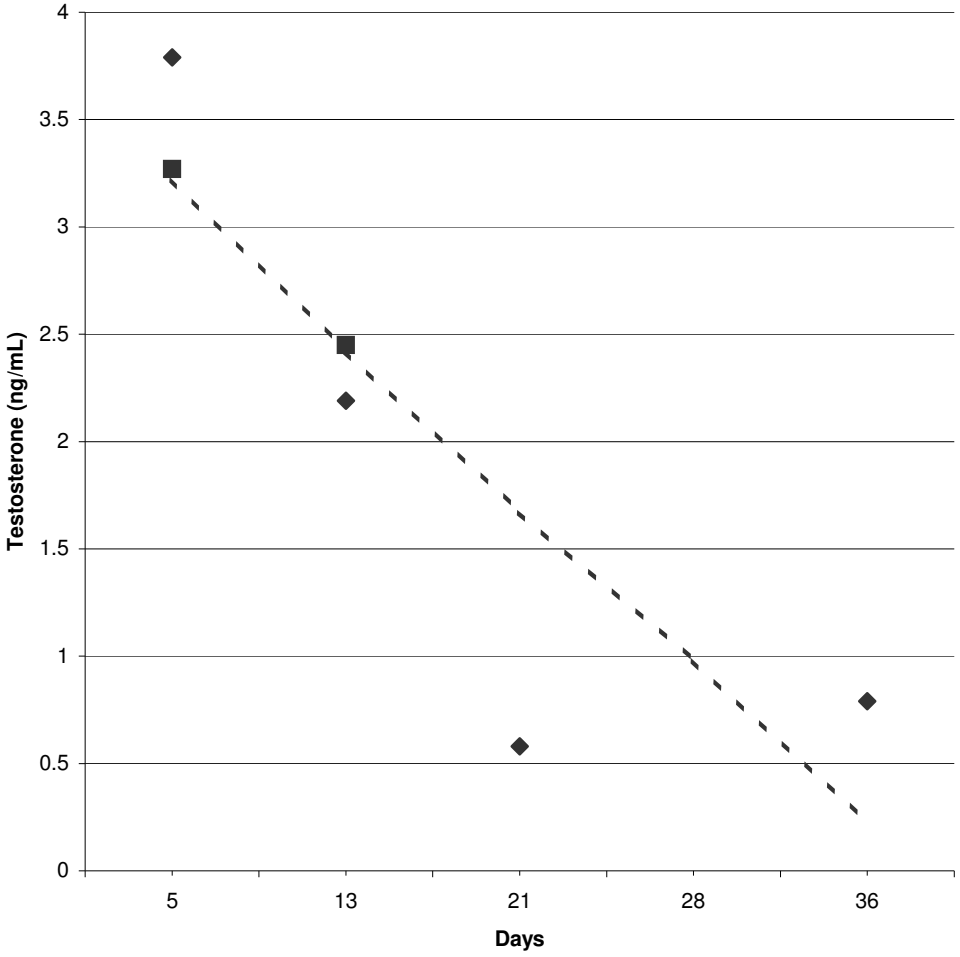

Figure 1. Sera testosterone concentrations (ng/mL) in gilts and sows administered testosterone propionate via intravaginal inserts (diamonds are actual mean values of testosterone in gilts and sows that maintained pregnancy; squares are actual mean values of testosterone in gilts and sows that aborted; the line is the best fit line for the gilts and sows that maintained pregnancy).