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Alteration of the Estrous Cycle of Swine with Exogenous Pituitary Gonadotrophins

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SUMMARY

A total of 43 gilts and sows were injected with a follicle-stimulating hormone preparation (Armour's Pituitary Gonadotrophin) in a study designed to develop a method of controlling the occurrence of estrus and ovulation in swine.

Forty-five percent of 22 sows and 48 percent of 21 gilts exhibited estrus 20 to 22 days, inclusive, following treatment. Fertility data obtained on the sows and a sample of the gilts indicated that ovulation rate at the first post-treatment estrus and number of living embryos on approximately the 25th day of gestation were not influenced by the hormonal treatment. Aberrant post-treatment estrous cycles were observed in 16 animals (37%). Three animals returned to estrus less than 18 days following treatment and 13 animals had not exhibited estrus by the 23rd day following the FSH injection. Cystic follicles were observed in 3 animals with delayed estrus but no reason was apparent for the extended length of the estrous cycle in the remaining animals. The injection of estradiol cyclopentylpropionate or prolactin after the administration of FSH failed to reduce the amount of variation in the length of the post-treatment estrous cycle.

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INTRODUCTION

The inherent rhythmic nature of the estrous cycle of farm animals frequently operates to the disadvantage of the livestock producer. This has recently become more and more apparent to the swine producer operating under a system that makes intensive use of a central farrowing house. There is usually more variation in breeding dates and farrowing dates than desired. Group mating would provide distinct advantages toward more effective utilization of these facilities. The availability of a method of controlling the breeding dates of livestock would provide additional advantages to the livestock producer including increased convenience in the use of artificial insemination and more uniformity in the age and weight of feeder animals.

The objective of the present study was to investigate further the use of gonadotrophin injections to regulate estrus and ovulation in swine.

LITERATURE REVIEW

The 21-day estrous cycle of swine is regulated by the activity of corpora lutea which are formed following ovulation. Progesterone is produced by the corpus luteum which inhibits ovulation and estrus. Following regression of the corpus luteum on the 15th-16th day of the estrous cycle, estrus is subsequently manifested. Consequently, several studies designed to control estrus and ovulation in swine have employed the use of exogenous progesterone as a means of synchronizing the onset of estrus in a group of animals.

Ulberg *et al* (1951) and Baker *et al.* (1954) demonstrated the successful suppression of estrus in swine with daily injections of crystalline progesterone. More recently, Nellor (1960) demonstrated the oral effectiveness of 6-methyl-17-acetoxyprogesterone in controlling the time of estrus in gilts.

Although the dependable control of estrus can be attained by administering progestational compounds, they have not been found consistently satisfactory due to a reduction in the fertility level at the first post-treatment estrus and an increased incidence of cystic follicles following treatment. Dziuk and Baker (1962) developed a method to control the time of ovulation in gilts quite precisely by

feeding an orally active progestational compound for eight to 10 days followed by a single injection of human chorionic gonadotrophin five to eight days after the termination of the progestational treatment. No ovarian cysts were observed in animals subjected to this treatment.

Day *et al.* (1959) used an injection of follicle stimulating hormone to induce ovulation in gilts and, consequently, to superimpose an experimental estrous cycle on the existing cycle. With this procedure, estrus was expected to be synchronized due to the regression of the induced corpora lutea on approximately the same day. Although this treatment had no apparent effect on fertility level at the first post-treatment estrus or on the incidence of cystic follicles, it proved to be only partially effective due to increased variation in the length of the experimental estrous cycle initiated by the induced corpora lutea.

The present study was conducted to investigate further the application of this technique toward the regulation of estrus and ovulation in swine.

PROCEDURE

A total of 43 Poland China gilts and sows was included in this study. A complete mixed-ration was fed throughout the experimental period. Gilts were self-fed and sows were limited-fed. Daily checks for estrus were made with vasectomized or intact mature boars. Day-1 of the estrous cycle was defined as the first day that the female allowed the boar to mount.

A follicle-stimulating hormone preparation (Armour's Pituitary Gonadotrophin, predominantly FSH) was used to induce ovulation. To study the effects of varying levels of injected FSH on the interval to the first post-treatment estrus, 11 sows were injected with 15 Armour Units (A. U.) of FSH per animal and a similar group of sows was injected at a level of 30 A. U. per animal. The weight range of these sows at the time of slaughter was 325 to 475 pounds. The FSH was administered as a single intramuscular injection between the fifth and 16th day of the existing estrous cycle. Sows exhibiting the first post-treatment estrus at a time approximating one estrous cycle length following injection were bred and then slaughtered on the 23rd to 27th day of pregnancy. The numbers of corpora lutea and living embryos were determined at autopsy. Sows exhibiting an abnormal interval to the first post-treatment estrus were slaughtered and observations were made of the reproductive tract for gross ovarian abnormalities.

In a second study, a combined treatment of FSH and estradiol cyclopentylpropionate (ECP) or FSH and prolactin (LTH, Armour and Co.) was used to induce ovulation. Twenty-one sexually-mature gilts were injected with 15 to 30 A. U. of FSH per animal. Of these, eight gilts received no additional treatment, eight were injected with 4 mg. of ECP 24 to 48 hours after the FSH injection, and five gilts received a single injection of approximately 200 I. U. of prolactin three days after the FSH injection. Fertility data were obtained on a sample of seven gilts by recovery of ova to measure fertilization rate or by determining the number of living embryos 20-22 days after mating.

RESULTS AND DISCUSSION

Table 1 summarizes the results obtained for sows injected with 15 A. U. or 30 A. U. of FSH. Sows exhibiting estrus 20 to 22 days, inclusive, following the FSH injection were considered to be successfully synchronized. A three-day interval was considered to be an optimum response, although a longer target period of 18 to 24 days after the injection may also be considered a practical and acceptable interval in many swine operations. Estrus was adjusted favorably in 10 sows, or 45 percent of the total number injected. Nine of the 10 sows conceived when bred at the first post-treatment estrus. The average number of corpora lutea and the average number of living embryos per litter on the 25th day of gestation were 13.0 and 10.1 respectively. The average embryonic mortality rate was 22 percent. Therefore, the fertility level of the first post-treatment estrus was considered to be within the normal range existing in this herd.

Fourteen sows (64%) exhibited estrus 18 to 23 days, inclusive, following treatment. Since the normal estrous cycle of sows is considered to vary between 18 and 23 days, the data suggest that these animals were recycled by the hormonal injection and, also, demonstrated an experimental estrous cycle of normal length.

A normal post-treatment estrous cycle was not exhibited by eight sows included in the study. Two sows exhibited estrus less than 18 days after treatment and six sows showed an abnormally long experimental cycle. Short cycles, theoretically, could result from failure of the hormonal injection to induce ovulation, failure of the formation of functional corpora lutea from the induced ovulations, or premature regression of induced corpora lutea. The definite cause was not ascertained. Of six sows showing a long post-treatment estrous cycle, three were observed to have cystic follicles, which was most likely the primary cause of delayed estrus. No reason was apparent for the extended cycle length in the remaining three sows.

A level of 15 A.U. per sow appeared to be as effective in synchronizing estrous cycles as was 30 A.U. Fewer sows injected at the higher level had abnormally short cycle lengths but the difference was minor.

A trend toward shorter post-treatment estrous cycles was observed in animals injected prior to the ninth day of the estrous cycle. However, Day *et al.* (1959) observed little association between the stage of cycle that FSH was injected and length of the post-treatment estrous cycle.

The results of the investigation presented here and those of Day *et al.* (1959) indicate that the induction of an experimental estrous cycle superimposed on the existing cycle will successfully synchronize some of the animals but the percentage of treated animals controlled is too low to be completely satisfactory. Since the fertility level of the synchronized animals appears normal, the major limiting factor of the method appears to be the variation in the length of the experimental estrous cycle. Some variation beyond a three-day interval is inherent in the system due to biological variation in the length of the estrous

TABLE 1 -- REPRODUCTIVE RESPONSE OF SOWS TO A SINGLE INJECTION OF FOLLICLE-STIUMLATING HORMONE

Treatment and Sow No.	Day of Cycle Injected	Days from Injection to Estrus	Days between Estrous Periods	No. of Corpora Lutea	No. of Living Embryos	Ovarian Abnormalities
FSH (15 A.U.)						
1	10	21	31	12	11	None
2	10	21	31	16	9	None
3	10	22	32	12	8	None
4	9	21	30	10	10	None
5	9	21	30	11	11	None
6	11	20	31	15	9	None
7	5	17	22	10	8	None
8	9	14	23	14	12	None
9	13	-a	--	--	--	Cystic follicles
10	9	-a	--	--	--	None
11	11	-a	--	--	--	Cystic follicles
FSH (30 A.U.)						
12	16	21	37	- open -		Cystic follicles
13	16	22	38	11	5	None
14	15	22	37	17	15	None
15	15	23	38	- open -		None
16	10	22	32	13	13	None
17	9	18	27	12	12	None
18	16	-a	--	--	--	None
19	14	29	43	not bred		None
20	9	-a	--	--	--	Cystic follicles
21	5	18	23	not bred		None
22	5	18	23	not bred		None

a - Sows did not show estrus prior to slaughter.

cycle and the treatment is not designed to reduce this variability. However, the major disadvantages were that the first post-treatment cycle was considerably shorter—or longer—in some animals than the calculated 21-day period following the injection of FSH.

A correction of short post-treatment estrous cycles may be provided by improved methods of insuring the induction of ovulation in all animals treated and perhaps by supplemental hormonal therapy designed to stimulate the formation of functional corpora lutea. A most significant improvement in the dependability of the method would be attained by reducing the frequency of abnormally long estrous cycles following treatment.

The results reported by Day *et al.* (1959) suggest that incomplete luteinization of induced corpora lutea may be one cause of the extended post-treatment estrous cycle. However, it was found that the supplemental injection of 15 mg. of luteinizing hormone (Armour Pituitary Gonadotrophin, predominantly LH) following FSH treatment failed to correct this condition. Also, the incidence of cystic follicles was markedly increased in gilts injected with LH.

Since previous findings suggested the incomplete formation of corpora lutea as a possible cause of an aberrant length to the experimental estrous cycles, low levels of estradiol cyclopentylpropionate (ECP) were injected 24 or 48 hours after FSH treatment in an effort to correct this condition. Increased luteinization following estrogen administration in swine has been reported by Kidder *et al.* (1955). Table 2 summarizes the results of this study and also the influence of injecting prolactin three days after administration of FSH.

Ten of 21 gilts (48 percent) included in the study exhibited estrus 20 to 22 days, inclusive, following treatment. This was similar to the degree of successful synchronization obtained in the first phase of the present study. Thirteen gilts showed an estrous cycle of normal length (18 to 23 days) following treatment. One gilt returned to estrus 17 days after treatment and 7 gilts showed an abnormally long experimental estrous cycle. Therefore, the evidence suggests the use of a combined treatment that included ECP or prolactin failed to improve the percentage of animals synchronized.

Fertility data were obtained on seven animals (Nos. 1, 2, 3, 9, 11, 12 and 15). An average of 11.0 corpora lutea were present when these animals were slaughtered. All of 18 ova recovered from gilts numbered 12 and 15 were fertilized. The remaining five gilts checked for fertility were slaughtered 20 to 22 days after mating. Autopsy data revealed an average of 9.8 living embryos per litter and an average embryonic mortality rate of 9 percent.

It is felt that the results presented here indicate the need for further improvement in the uniformity of length of the experimental estrous cycle established by induced ovulation before practical application can be made of this procedure to synchronize estrous cycles in swine. The major cause of this variation appears to be the occurrence of abnormally long estrous cycles following treatment.

TABLE 2 -- REPRODUCTIVE PERFORMANCE OF GILTS ADMINISTERED ESTRADIOL CYCLOPENTYLPROPIONATE OR PROLACTIN FOLLOWING A SINGLE INJECTION OF FOLLICLE STIMULATING HORMONE

Treatment[a]	Day of Cycle Injected With FSH	Days From FSH Injection to Estrus (Experimental Estrous Cycle)
FSH		
1	12	22
2	12	22
3	12	40
4	b	21
5	b	19
6	b	21
7	b	22
8	b	36
FH + ECP[d]		
9	12	24
10	13	24
11	13	20
12	5	21
13	15	c
14	b	c
15	b	20
16	b	20
FSH + PROLACTIN[e]		
17	b	25
18	b	21
19	b	18
20	b	17
21	b	19

a. All gilts received 15 A.U. of FSH per animal with the following exceptions: Nos. 4 & 5; 22 A.U. & nos. 6, 7, 8; 30 A.U.

b. Stage of estrous cycle was not determined prior to treatment.

c. Gilts had failed to show a post-treatment estrus. Both gilts were slaughtered 29 days after the FSH injection.

d. Estradiol cyclopentypropionate at a level of 4 mg. per animal 24 hrs. after FSH (Nos. 9, 10 and 11) or 48 hrs. after FSH injection (Nos. 12, 13, 14, 15 and 16).

e. Prolactin at level of approximately 200 I.U. per animal.

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