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Effects of estrus synchronization using Matrix® followed by treatment with the GnRH agonist triptorelin to control ovulation in mature gilts

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ABSTRACT

Estrus and ovulation responses in Matrix-treated gilts may affect ovulation synchrony in response to triptorelin. In experiment 1, estrus and ovulation measures at 12 h intervals after last Matrix feeding (LMF) were analyzed. For the 398 gilts that displayed estrus, 87.4% were detected on Days 6–8 after LMF. Duration of estrus was 24–60 h for 85.6% of gilts and negatively correlated with interval from LMF to estrus ($r = -0.53$, $P < 0.0001$). The estrus to ovulation interval was positively correlated with duration of estrus ($r = 0.61$, $P < 0.0001$). In experiment 2, gilts ($n = 96$) received intravaginal treatment with 2 mL of gel containing placebo (Control) at 96 h, 200 μg of triptorelin at 96 h (TRP96), 120 h (TRP120) or 144 h (TRP144) after LMF. Estrus measures did not differ ($P > 0.10$) among treatments. The proportion of gilts ovulating 32–56 h after treatment was greater for TRP120 and TRP144 ($P < 0.01$) compared to other treatments. The treatment to ovulation intervals for all triptorelin treatments were shorter ($P < 0.001$) than Control. In experiment 3, gilts ($n = 86$) received placebo (Control), 100 μg (TRP100), 200 μg (TRP200), or 400 μg (TRP400) of triptorelin at 120 h after LMF. There was no effect of treatment ($P > 0.10$) on estrus or on interval from LMF to estrus. The proportion of gilts ovulating by 40, 48 and 56 h after treatment increased ($P < 0.05$) with triptorelin compared to Control. Our results indicate that gilts receiving 100–400 μg of triptorelin at 120 h after LMF had the greatest ovulation synchrony 24–48 h following treatment. These studies provide important information for developing a procedure for a single insemination in synchronized gilts.

1. Introduction

Induced ovulation and single fixed time artificial insemination (SFTAI) will help increase the rate of genetic progress and improve AI timing in swine. Use of this technology was reported in weaned sows with induction of ovulation followed by single or multiple timed inseminations (Brussow et al., 2009; Driancourt et al., 2013; Knox et al., 2014). Ovulation synchrony was effective in sows, since weaning litters from sows within a short period of time initiates a synchronous start of the follicular phase and results in most sows expressing estrus 4–6 days later (Foxcroft and Hunter, 1985; Weitze et al., 1994). Others attempted to improve synchrony of follicle development after weaning by inducing follicular development at weaning using gonadotropins followed by ovulation induction and timed inseminations (Hühn et al., 1996). Regardless of the approach, the success of ovulation induction relies on

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treatment of weaned sows which have follicles that respond to an LH surge (Knox et al., 2011). Approximately 80% of sows with ovaries containing mature follicles ovulate by 32–48 h following ovulation induction treatment (Driancourt et al., 2013; Knox et al., 2014).

The practical use of ovulation control for SFTAI technology in replacement gilts will require a method to synchronize the start of the follicle phase. Replacement gilts enter the breeding herd randomly based on expression of puberty, and therefore, lack any significant degree of estrous cycle synchrony (Klindt et al., 2001). Synchronization of estrus in groups of randomly cycling gilts was effectively accomplished by use of the synthetic progestagen, altrenogest (Davis et al., 1985). This progestagen was approved by the United States Food and Drug Administration under the names of Regumate and Matrix (Merck Animal Health, Whitehouse Station, NJ). Matrix is fed to cycling females for 14 d with estrus occurring 4–9 d following the last Matrix feeding (Kraeling et al., 1981; Wood et al., 1992; Horsley et al., 2005).

In mature gilts, approaches towards use of a SFTAI have been reviewed (Hühn et al., 1996; Brussow et al., 2009; Driancourt, 2013; De Rensis and Kirkwood, 2016). Much of the information is limited and the methodology quite variable. Differences in the approach and effectiveness appear to result from: 1) whether gonadotropins such as eCG were used to synchronize follicle development, 2) which induction hormone was used (GnRH or one of its agonists, pLH, or hCG), 3) the dosage and time of administration for the induction hormone, and 4) the time of AI following induction. At the present time, the most practical approach for a SFTAI in mature gilts relies on prior synchronization of estrus before ovulation induction (Driancourt, 2013), although there are reports of administration at estrus as well (Ulguim et al., 2014). Variation in the timing for hormone induction following progestagen treatment can range from 55 to 104 h if eGG was used and in the 94–120 h range without use of eCG (Degenstein et al., 2008; Martinat-Botté et al., 2010). For AI timing, some studies used multiple fixed time inseminations, with both inseminations occurring between 24–48 h (Brüssow et al., 1996), while with SFTAI, the AI may range from 24 to 33 h following hormone induction (Driancourt, 2013).

When using a novel intravaginal delivery system for the GnRH agonist, triptorelin, there is no information on the optimal timing of administration following progestogen treatment. The aim of the present study was to assess variation in ovulation patterns of mature gilts following progestogen synchronization and to determine the best approaches for synchronizing ovulation when using the intravaginal triptorelin gel. This paper describes three studies that: 1) characterized the estrus and ovulation responses in Matrix-treated gilts; 2) determined the optimum timing of triptorelin administration; and 3) evaluated the effect of dose of the GnRH agonist, triptorelin, when given in an intravaginal gel following estrous synchronization in gilts.

2. Materials and methods

Use of animals in all experiments was approved by the Institutional Animal Care and Use Committee of the University of Illinois (protocol #07083).

2.1. Experiment 1. Time of estrus and ovulation in Matrix-treated gilts

Experiment 1 was conducted at the University of Illinois Swine Research Center. Prepubertal crossbred Genetiporc (PIC, Hendersonville, TN) gilts (n = 398) were relocated from a finishing barn into a breeding and gestation building at 170 d of age and then checked for estrus using once daily fenceline exposure to a mature boar. Following detection of first estrus, gilts were moved into stalls and fed 15 mg of Matrix (altrenogest, 2.2 mg/mL, Merck Animal Health, Madison, NJ) as a top dress on a small amount of the daily feed once daily for 14 consecutive days. Following the last Matrix feeding (LMF), gilts were exposed to a mature boar and checked for estrus using twice daily fenceline contact at 0600 and 1800 h with application of the back-pressure test. Ovulation data was also obtained at 12 h intervals using transrectal real-time ultrasound starting at onset of estrus and continuing until ovulation was completed (Knox et al., 2002). Ovulation was determined based on the disappearance of all large follicles ($\geq$6.5 mm), or when the total number of large follicles from the combined counts of both ovaries was < 4 and occurred in conjunction with a clear reduction in the total count from the previous observations.

2.2. Experiment 2. Time of ovulation in gilts receiving triptorelin at various intervals after LMF

Experiment 2 was performed at the JBS United Animal Health Research farm in Sheridan, IN in an environmentally regulated 1000 sow breeding and gestation barn. Mature PIC gilts (n = 96) that had expressed a previous estrus were moved into individual stalls. Estrous cycles were synchronized using Matrix as described in Experiment 1. Following LMF, gilts were individually weighed and then randomly assigned by age (218–253 d) and weight (125–174 kg) to Control (2 mL of placebo gel administered intravaginally at 96 h after LMF, n = 23), TRP96 (200 μg triptorelin in 2 mL of gel administered intravaginally at 96 h after LMF, n = 24), TRP120 (200 μg triptorelin administered 120 h after LMF, n = 25) or TRP144 (200 μg triptorelin administered at 144 h after LMF, n = 24). Ultrasound examination of ovaries was performed at 8 h intervals starting at 128 h (5.3 d) after LMF and continued until ovulation was confirmed or until 200 h (8.3 d) after LMF, whichever came first. Determination for ovulation was performed as described in experiment 1.

2.3. Experiment 3. Effect of dose of triptorelin on ovulation when administered to gilts at 120 h following LMF

Experiment 3 was also performed at the same JBS United Animal Health Research Farm as Experiment 2. Mature PIC gilts (n = 86) that had expressed first estrus were moved into stalls and fed Matrix as previously described. At the time of LMF, gilts were