Abstract

This study reviewed the protocols for ovulation induction in sows by human chorionic gonadotropin (hCG) and gonadotropin releasing hormone (GnRH). In pigs, it was documented that ovulation usually occurred about 70% of the way through oestrus. However, the duration of oestrus in sows highly varies, producing difficulty in performing artificial insemination (AI) in sows at optimal time. In practice, sows are usually inseminated for 2 to 4 times at 12 to 24 hours interval during oestrus, with an attempt to deposit sperm at the optimal time of ovulation. Many protocols have been developed to control time of ovulation, allowing fixed time insemination in gilts and sows. Hormones used for ovulation induction included hCG, GnRH and porcine luteinizing hormone (pLH). The purpose of treatment for weaned sows with hCG, GnRH or pLH performed after gonadotrophic treatment at weaning is to stimulate follicular growth. Such treatments at weaning period are associated with an increase in embryo mortality due to poorer oocyte quality. GnRH and hCG mechanisms of action on ovulation induction are different: GnRH induces ovulation by providing a pre-ovulatory peak of LH, while hCG acts directly on LH receptors on ovarian follicle cells.

Keywords: hormone, ovarian cysts, reproduction, swine, ultrasonography

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Introduction

In intensive swine industry, herd productivity is largely dependent on individual sow reproductive performance such as litter size, farrowing rate and weaning-to-oestrus interval (Tummaruk et al., 2000). Optimal time to mate the female pigs is a key factor influencing both fertility and fecundity. Nowadays, artificial insemination (AI) in pigs is worldwide used in the pig industry. In practice, 2-5 billion sperm in 80-100 ml solution are used for insemination in sow intracervically 2-4 times during standing oestrus. It has been estimated that up to 25% of the spermatozoa loss is due to semen backflow within a few hours after insemination (Steverink et al., 1998). The rest of the spermatozoa is transported through the uterine horns before reaching the sperm reservoirs in the caudal part of the oviducts and <1% of sperm that were inseminated was recovered in both sides of the sperm reservoir (Mburu et al., 1996; Sumransap et al., 2007; Tummaruk et al., 2007). Furthermore, during the last decade, many new sperm biotechnologies, e.g. frozen-thawed semen and sex-sorted sperm, have been developed (Chanapiwat et al., 2009). The frozen-thawed or flow cytometric sex-sorted sperm have a shorter life span than those obtain from fresh semen. Therefore, fertilization from these sperms needs to be improved as soon as possible after insemination. These findings indicate that AI protocols performed in the pig farms should be improved. In addition, in north hemisphere, it has been reported that fertility during warmer months of the year is compromised because the variability of the oestrus-to-ovulation interval (EOI) increased. This, in turn, results in the sperm deposition at unsuitable time relative to ovulation, causing a reduction in fertility (Peltoniemi et al., 2000; Auvigne et al., 2010; Tummaruk et al., 2010). The objectives of the present study were to review the application of hormones in pig raised in the tropics; and the use of human chorionic gonadotrophin (hCG) and gonadotropin releasing hormone (GnRH) for induction of ovulation in fixed time AI protocol.

Ovulation time in sows

In pigs, ovulation occurs about two-thirds or 70% of the oestrus duration (Soede et al., 1995; Anuvongnukroh et al., 2004) (Table 1). However, a high variation of oestrus duration was observed. This made the difficulty in performing AI in sows at optimal time. The variability of the interval between onset of oestrus and ovulation is exacerbated in heat-stressed animals, making it even more difficult to synchronize AI within the ovulation time. In practice, sows are usually inseminated for 2 to 4 times at 12 to 24 hours interval during oestrus. This is to make an attempt to deposit sperm at the optimal time relative to the ovulation. Time of ovulation in pig in relation to the onset of oestrus is summarized in Table 1.

Table 1 Mean±SD and range of duration of oestrus, Interval from onset of oestrus-to-ovulation and time of ovulation in relation to oestrus duration in sows (modified after Tummaruk, 2003)

<table>
<thead>
<tr>
<th>Duration of oestrus (hours)</th>
<th>Interval from onset of oestrus-to-ovulation (h)</th>
<th>Time of ovulation in relation to oestrus duration (%)</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>56±8 (46-53)</td>
<td>37±2 (35-43)</td>
<td>68 (54-78)</td>
<td>Mburu et al. (1995)</td>
</tr>
<tr>
<td>60±15 (32-96)</td>
<td>45±13 (15-85)</td>
<td>71 (35-100)</td>
<td>Weitze et al. (1994)</td>
</tr>
<tr>
<td>50±13 (24-88)</td>
<td>35±8 (10-58)</td>
<td>72 (39-133)</td>
<td>Soede et al. (1995)</td>
</tr>
<tr>
<td>52±13 (24-88)</td>
<td>39±11 (18-60)</td>
<td>75</td>
<td>Anuvongnukroh et al. (2004)</td>
</tr>
<tr>
<td>56.0±5.1 (24-104)</td>
<td>40.0±4.4 (10-85)</td>
<td>71.6±2.5 (35-133)</td>
<td>All</td>
</tr>
</tbody>
</table>

Fixed time insemination in gilts and sows

As recently reviewed by Bruss/sø et al. (2009), protocols to control time of ovulation have been developed, contributing to fixed time insemination in gilts and sows. Hormones used in such procedure include human chorionic gonadotropin (hCG) (De Rensis et al., 2003; Cassar et al., 2004), gonadotropin releasing hormone (GnRH) (De Rensis et al., 2003; Martinat-Botte et al. 2010) and porcine luteinizing hormone (pLH) (Cassar et al., 2005; Abad et al., 2007). It has been demonstrated that female pigs tend to ovulate about 42 hours after administration of hCG (Hunter 1967; Roca et al., 2003), and about 38 hours after GnRH (Bruss/sø et al., 2009) or LH (Abad et al., 2007) treatments. However, with few exceptions, treatments for weaned sows with hCG, GnRH or pLH subsequent to a gonadotrophic treatment at weaning period aim at stimulating follicular growth. Such treatments at weaning period have been associated with increased embryo mortality due to the poorer oocyte quality
The use of PG600® in pigs

PG600® is a hormone commonly used for oestrus induction in gilts and sows. PG600® is a combination of two hormones, eCG 400 IU and hCG 200 IU. In general, the use of PG600® in gilts age 150-180 days can successfully induce oestrus within 3-7 days in up to 90% of the gilts (Knox et al., 2000). It has been demonstrated that subcutaneous administration of PG600® is more effective than intramuscular administration (Knox et al., 2000). This might be due to the fact that the level of hCG may remain in the tissues via subcutaneous administration more than intramuscular administration. hCG is slowly released to allow follicular growth until ready to response to hCG. Intramuscular administration of PG600® leads to a high rate of absorption and it can stimulate only follicles with diameter of larger than 5 mm. The pigs with small follicles may not respond. Breen et al. (2006) demonstrated that the modification of PG600® dosage might increase the incidence of cystic ovaries in weaned sows (Table 3). In addition, in some herds the use of PG600® in pigs
PG600® is recommended for primiparous sows weaned during summertime to avoid the evidence of second parity drop (Vargas et al., 2006).

<table>
<thead>
<tr>
<th>Table 3 Effect of different doses of PG600® in weaned sows (modified after Breen et al., 2006)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
</tr>
<tr>
<td>Number of sows</td>
</tr>
<tr>
<td>Percentage in oestrus (%)</td>
</tr>
<tr>
<td>Cystic ovaries (%)</td>
</tr>
<tr>
<td>Conception rate (%)</td>
</tr>
<tr>
<td>Farrowing rate (%)</td>
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</tbody>
</table>

**Conclusion**

Both hCG and GnRH are exogenous hormones that have the potential to control time of ovulation in naturally cyclic sows and pubertal gilts. This proficiency can facilitate timed insemination of single or multiple semen doses having low sperm concentration.

**Acknowledgements**

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**References**


Dependence upon the period of the cycle.

