Agriculture and Natural Resources xxx (2017) 1–7

Contents lists available at ScienceDirect

Agriculture and Natural Resources

journal homepage: http://www.journals.elsevier.com/agriculture-and-natural-resources/

Original Article

Effects of altrenogest treatment in sows on the variation of piglet birth weight and pre-weaning piglet performance

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ARTICLE INFO

Article history:
Received 4 July 2016
Accepted 27 February 2017
Available online xxx

Keywords:
Altrenogest
Birth weight variation
Piglet
Pre-weaning
Sow

ABSTRACT

The effect of altrenogest (ALT) feeding combined with induced ovulation by human chorionic gonadotropin (hCG) in sows was evaluated on piglet birth weight (BW) variation and pre-weaning performance. Sows were divided into four groups: the control (no ALT; without hCG induction; artificial inseminated (AI) at 12 and 36 h after estrus; $n = 40$), ALT + hCG72 (ALT 20 mg/d, D-4–D2 (D0: weaning day); hCG 750 IU at 72 h post ALT; AI at 24 and 40 h after hCG; $n = 41$), ALT + hCG96 (ALT 20 mg/d, D-4–D2; hCG 750 IU at 96 h post ALT; AI at 24 and 40 h after hCG; $n = 41$) and ALT + no hCG (20 mg/d, D-4–D2; without hCG induction; AI at 12 and 36 h after estrus; $n = 41$). The results revealed that piglet BW was not different among the groups ($p > 0.05$). However, the standard deviation of piglet BW (SDBW) was lower in ALT + hCG72 (0.32 ± 0.02 kg; $p = 0.032$), compared to ALT + hCG96 (0.40 ± 0.02 kg) and ALT + no hCG (0.40 ± 0.02 kg), except for the control (0.39 ± 0.02 kg). In addition, the pre-weaning mortality rate (%PWM) due to underweight elimination at weaning (below 3.50 kg) was decreased in ALT + hCG72 (8.33%) compared to the control (32.50%; $p = 0.007$) but similar to ALT + hCG96 (10.71%) and ALT + no hCG (24.05%). Therefore, ALT + hCG72 treatment in sows could reduce piglet BW variation and the number of piglets eliminated at weaning.

Introduction

Increased litter size (LS) has some bearing on a reduction in mean piglet birth weight (BW); concomitantly, a greater proportion of low BW piglets (1 kg or less) results in higher variability of piglet BW within the litter. This problem decreases the viability of low BW piglets and their growth performance during lactation (Quiniou et al., 2002) because they have less ability to compete with their littermates to receive the required level of colostrum and milk intake (Le Dividich, 1999).

The difference in piglet BW initiates during early pregnancy (Patterson et al., 2008) including the pre-implantation and post-implantation periods. The causes of piglet BW variation are: heterogeneous oocyte maturation (6.5–10.0 mm) (Knox, 2005), variation in ovulation time (1–9 h) (Pope, 1994), the positioning of implantation (Perry and Rowell, 1969) and placental efficiency (Wilson et al., 1999). Thus, the improvement of follicular development and reducing the range in ovulation time may decrease the piglet BW variation that takes place during the pre-implantation period.

Several studies indicated that supplementation of ALT (orally-synthetic progesterone) to the sows during the pre- and post-weaning periods could enhance reproductive performance (van Leeuwen et al., 2011a) through improving the follicular growth, such as increasing the follicular size at the beginning of the follicular phase (van Leeuwen et al., 2011b) and generating a more homogeneous pool of pre-ovulatory follicles (Kitkha et al., 2014). hCG was used in a fixed-time artificial insemination (AI) protocol for a predictable time of ovulation (Brüssow et al., 1996; Hühn et al.,

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https://doi.org/10.1016/j.anres.2017.02.006

1996; Brüssow and Wähner, 2011; Wongkaweewit et al., 2012). Ovulation in female pigs occurred within 42 h after hCG injection (Hunter, 1967; Roca et al., 2003; Tummaruk et al., 2011).

Therefore, the objective of this study was to evaluate the effect of ALT treatment in sows during the peri-weaning period, accompanied with ovulation induction by hCG after ALT withdrawal on piglet BW variation, PWM and pre-weaning piglet performance.

Materials and methods

Housing, animals and diets

Animal manipulations in this study were approved by the Animal Usage and Ethics Committee, Kasetsart University (ACKU 03555). The study was conducted on a commercial sow breeding farm in Chiang Mai, Thailand (18°47′25″ N, 98°59′04″ E), housing 5000 sows and using an evaporative cooling system during the rainy season (January–June 2014).

Gestating sows were kept in gestation crates and moved to a farrowing barn 1 wk before the expected day of parturition. The farrowing pen was composed of a farrowing crate on a slatted floor under the sow and a metal slatted floor under piglets. A heat lamp was placed inside the metal box, which was beside the sow, to provide heat for the piglets. The average temperature varied between 22.90 ± 0.50 °C to 26.50 ± 0.50 °C in the gestation barn, and 22.00 ± 0.20 °C to 23.70 ± 0.20 °C in the lactation barn.

Lactating crossbred sows (Landrace × Large White; $n = 163$), parity 3–6 and body condition score (BCS) 2.0–2.5 were used in the study. The sows' BCS was assessed according to the method used by Alexander and Muirhead (1997). The sows had parity, BCS at weaning, LS, nursing piglets (NP), piglets weaned per litter (PWL) and lactation length (LL) on average of 4.18 ± 0.10, 2.24 ± 0.02, 16.75 ± 0.30 piglets, 11.86 ± 0.17 piglets, 11.67 ± 0.21 piglets and 26.97 ± 0.09 d, respectively.

The sows and their piglets were fed a corn and soybean-based diet that provided higher nutrient requirements than the National Research Council (NRC, 2012) recommendation. Drinking water was provided *ad libitum*.

During lactation, all sows were fed the lactation diet *ad libitum*. The lactation diet contained 18.08% crude protein (CP), 3314.47 kcal/kg metabolizable energy (ME) and 1.16% lysine (Lys). After mating, the sows were fed with the gestation diet twice daily at 0700–0730 h and 1230–1330 h. The feeding level was controlled depending on the sow's BCS. Gestation diets were divided into two phases, during weeks 1–11 of gestation, the diet contained 15.51% CP, 3047.53 kcal/kg ME and 0.93% Lys (BCS < 3.0; 2.8 kg/d: BCS = 3.0; 2.4 kg/d: BCS > 3.0; 2.0 kg/d) and during the weeks 12–15 of gestation, the diet contained 16.41% CP, 3048.18 kcal/kg ME and 0.94% Lys (BCS ≥ 3.0; 2.8 kg/d: BCS < 3.0; 3.2 kg/d).

The piglets were individually weighed at birth and their birth characteristics were identified and recorded; for example mummified fetuses (MM), stillborn piglets (SB) and born alive piglets (BAL). At 24 h after birth, they were teeth-clipped, tail-docked and litter sizes were equalized by cross-fostering within the same group. All piglets received iron dextran at age 4 d. Males were castrated at age 5 d. At age 14 d, creep feed (20.65% CP, 3544.83 kcal/kg ME and 1.50% Lys) was provided to piglets at 0.01 kg/piglet/d on average. The piglets were weighted individually again at weaning.

Altrenogest treatments

Sows were divided into four groups (Table 1). Control sows ($n = 40$) did not receive ALT (Altresyn®; Ceva Sante Animale; Libourne, France). Estrus monitoring detection and traditional artificial insemination (AI) in sows were carried out for 7 d after weaning at 0800–900 h and 1500–1600 h by trained farm technicians using fence-line boar contact. Estrus signs were indicated when the sows exhibited a standing heat reflex during a back pressure test in the presence of a boar. AI with pooled fresh semen was carried out at 12 and 36 h after estrus expression.

The sows in ALT + hCG72 ($n = 41$) were treated with ALT for 7 d, from 4 d before weaning (D-4; D0 = weaning day) to 2 d post weaning (D2) at 20 mg/d, as a top dressing over a small portion of feed prior to receiving their large meal at 1230–1330 h. After ALT withdrawal, estrus signs were detected and ovulation was induced using chorionic gonadotropin (hCG) 750 IU, i.m. (Chorulon®; Intervet/Schering Plough; Boxmeer, the Netherlands) (Wongkaweewit et al., 2012) at 72 h (1400–1500 h) post ALT withdrawal. Then, fixed times were implemented for AI at 24 and 40 h post hCG injection. The method of fixed-time AI was adapted from the protocols of Hühn et al. (1996) and Brüssow et al. (1996).

For ALT + hCG96 ($n = 41$), the sows were treated with ALT using the same regimen as the sows in ALT + hCG72, but ovulation was induced using hCG at 96 h (1400–1500 h) post ALT withdrawal. The fixed time AI of this group was at 24 and 40 h post hCG injection.

Lastly, the sows in ALT + no hCG ($n = 41$) were treated with ALT the same as the sows in ALT + hCG72 and ALT + hCG96 but there was no ovulation induction. Estrus detection started immediately after ALT withdrawal and continued for 7 d. The sows in ALT + no hCG were inseminated at 12 and 36 h post estrus expression (Table 1).

After insemination, the sows were reared under the general farm management system during gestation and lactation.

Data collection

Sows were detected for estrus for 7 d post weaning (control) or post ALT withdrawal (ALT + no hCG), whereas, the sows in ALT + hCG72 and ALT + hCG96 were detected for estrus post ALT withdrawal until hCG injection and fixed-time AI; these data were calculated as the percentage of estrus. The pregnancy rate (%) was determined at 30 d of pregnancy (PigLIVE version 3.0; Live Informatics Co., Ltd.; Nonthaburi, Thailand) and the farrowing rate was recorded at birth.

At birth, information was recorded on piglets and piglets' characteristics such as the number of mummified fetuses (MM), the percentage of MM (%MM), the number of stillborn piglets (SB), the percentage of SB (%SB) and the number of born alive piglets (BAL), piglet BW, the coefficient of variation of piglets' BW (%CVBW), SDBW and the percentage of small piglets (%Small) or piglets that weighed less than 1 kg. The piglets that died during lactation were indicated as the number of PWM piglets and %PWM. Additionally, the causes of piglet death were recorded: elimination after birth (BW < 0.70 kg), elimination at weaning (BW < 3.50 kg), crushing, weakness and others.

After weaning, data were recorded of the number of PWM piglets, %PWM, the number of piglets weaned per litter (PWL), weaning weight (WW), the coefficient of variation of piglets' weaning weight (%CVWW), the standard deviation of piglets' weaning weight (SDWW) and average daily litter weight gain (ADLWG).

Statistical analyses

Normality of co-factors was checked using the Shapiro-Wilk test. The difference of co-factors among the groups was tested by one-way analysis of variance (SPSS version 18; SPSS Inc., Chicago, IL, USA).

The data on percentage of estrus, pregnancy rate and farrowing rate were compared using the Fisher's exact test (Mcdonald, 2008) and a modification of the Bonferroni-corrected, pairwise technique (MacDonald and Gardner, 2000). The sows in the control and