Indian Journal of Animal Sciences **93** (12): 1190–1192, December 2023/Short communication
https://doi.org/10.56093/ijans.v93i12.129969

Development of a new protocol for estrus induction and synchronization in multiparous weaned sows

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Received: 23 November 2022; Accepted: 19 September 2023

Keywords: Estrus induction, Multiparous sows, P.G. 450, P.G. 600, Reproductive performance, Synchronization

In India, pig production system is undergoing transformation to meet the rising demand of pork. The majority of pig population is present in North Eastern Hill (NEH) region (Singh *et al*. 2020a, Sharma *et al*. 2020). In NEH region, pigs are raised in backyard production system with low inputs and low outputs (Sharma *et al*. 2020, Singh and Mollier 2020). However, in recent times, commercial pig production has picked-up pace in North and South India (Singh and Mollier 2020). There is growing demand for increasing the efficiency and sustainability of the pig farms. The sustainability is linked with optimal reproductive efficiency of the animals. The reproductive efficiency of pig is measured in terms of number of weaned piglets produced per sow in a year (Stalder 2014). However, due to numerous factors, such as season (hot-humid), nutrition, disease, lactation stress, high weaning age, reproductive efficiency is compromized (Kraeling and Webel 2015, Singh *et al*. 2021). This causes increased non-productive days and production of less numbers of piglets per sow per year. Therefore, to optimize the reproductive efficiency, estrus induction and synchronization is an effective strategy (Singh *et al*. 2022).

In pigs, estrus induction and synchronization is done by managerial and hormonal manipulation of estrous cycle (Kraeling and Webel 2015, De Rensis and Kirkwood 2016). The main goal is to stimulate the follicular development and subsequent ovulation at fixed time. To achieve this, P.G. 600 is routinely used in pre-pubertal gilts and in sows at the time of weaning (Eckhardt *et al*. 2014, Knox 2014). P.G. 600 includes equine chorionic gonadotropin (400IU) and human chorionic gonadotropin (200IU), which causes follicular development and ovulation, respectively. Gonadotropin treatment is also useful in sows at weaning to prevent delayed return to estrus associated with season and parity (Estill 2000, Breen *et al*. 2006). It has been reported previously that use of P.G. 600 induced estrus in 50-90% pre-pubertal gilts and 50-95% weaned sow (Breen *et al*. 2006, Knox 2014, Singh *et al*. 2022).

However, there is no report of estrus induction and synchronization in weaned multiparous sow in India under sub-tropical climate. Also, the P.G. 600 was developed for sows raised in Europe and Northern America where body weight of sow is higher than in India. Furthermore, the readymade P.G. 600 is not available in India and has to be formulated by using eCG and hCG. Considering the above, there is an urgent need to develop low-cost, effective protocols suitable for Indian conditions. Therefore, the aim of the present study was to evaluate the efficacy of P.G. 450 protocol for estrus induction and synchronization in multiparous weaned sows and its comparison with the P.G. 600 protocol.

The experiment was performed at Pig Research Farm of ICAR Research Complex for NEH Region, Nagaland Centre, Medziphema, during the year 2020 and 2021 and was approved by Institute Animal Ethics Committee. The climate of the region is sub-tropical with hot humid summer. The sows were of crossbred (Gunghroo×Hampshire) genotype. The animals were housed in individual pen and provided commercial pig breeder feed. The sows used in this study were of 3rd to 5th parity and with an average body weight 138.25±2.53 kg. The animals were randomly divided into two groups. In group-I, sows (n=40) were injected with P.G. 600 (eCG 400 I.U. and hCG 200 I.U.) and in group-II, P.G. 450 (eCG 300 I.U. and hCG 150 I.U.) intramuscularly. For the treatment, eCG and hCG were mixed in sterile water at the time of injection and administered in 3 mL volume intramuscularly in the neck using a 18 gauge needle. The weaning to treatment interval was 11.57±1.08 and 12.97±1.17 days in group-I and group-II, respectively and it was not significantly different ($p>0.005$). Estrus detection was performed using mature boar along with visual signs of estrus (swelling and redness of vulva, grunting, frequent urination, mounting on wall, restlessness and back pressure test) in morning and evening at 12 h interval. Estrus induction was calculated as the proportion of treated sows that exhibited estrus. Time

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Table 1. Effect of two different protocols for estrus induction and synchronization on reproductive performance of multiparous sows (mean±SEM)

Attribute	Group-I (n=40) P.G. 600	Group-II (n=40) P.G. 450	p-value
Weaning to treatment interval	11.55±0.76[a]	12.97±0.95[a]	0.24
Estrus induction (%)	80[a]	87.5[a]	0.36
Treatment to estrus induction interval (h)	65.59±1.69[a]	67.57±2.19[a]	0.99
Estrus duration (h)	67.21±0.87[a]	66.82±0.68[a]	0.74
Farrowing rate (%)	87.5[a]	91.42[a]	0.59
Live born piglets	9.78±0.31[a]	10.46±0.28[a]	0.16
Still-births	0.32±0.07[a]	0.37±0.07[a]	0.67
Total litter size at birth	10.10±0.33[a]	10.84±0.32[a]	0.17
Litter size at weaning	8.92±0.26[a]	9.62±0.20[a]	0.07
Pre-weaning mortality (%)	8.75[a]	8.05[a]	0.75

Means with same superscript in a column did not differ significantly (p >0.05).

interval from injection of hormone to first detection of estrus was also recorded. The duration of estrus was defined as the period from the first standing observation to the time of the first negative standing response (Breen *et al*. 2006). On detection of estrus, sows were inseminated after 24 h of first detection and repeated again after 12 h. Artificial insemination was done using Golden Gilt (IMV, France) catheter. Semen used for insemination was collected at farm and processed in BTS extender with a concentration of 3×10^9 spermatozoa per dose. The extended semen was used within 72 h of collection as per standard procedure. The farrowing rate was calculated as the proportion of inseminated females that farrowed. Additionally, total piglets born/litter, live-born piglets/litter, stillborn piglets/litter, and litter size at weaning were recorded. Pre-weaning mortality was defined as the death of live born piglets till 42 days of age (weaning time).

All statistical analyses were performed using SPSS v. 27. Estrus induction, farrowing rate and pre-weaning mortality were compared using Pearson's χ^2 test. Student t-test was performed to study the differences between means of two groups. Quantitative variables were summarized as mean±standard error of mean (SEM). Differences were considered statistically significant at 95% confidence level ($p<0.05$).

The present study compared the efficacy of two different protocols for estrus induction and synchronization in multiparous weaned sows. Estrus induction was numerically higher in group-II but statistically non-significant ($p>0.05$) (Table 1). Breen *et al*. (2006) reported estrus induction of 90% in weaned sows with P.G. 300, P.G. 600 and P.G. 900 and there was no effect of different doses. Singh *et al*. (2022) recorded 80% estrus induction in gilts and sows in field condition using P.G. 450, however, the study lacked the control group. It has been well-established that P.G. 600 injection induced estrus in 50-90% pre-pubertal gilts (Breen *et al*. 2006, Knox 2014).

In this study, estrus was induced within three days in multiparous weaned sows in both the groups ($p>0.05$). The estrus duration was non-significantly ($p>0.05$) different in both the groups. Singh *et al*. (2022) reported that estrus was induced within 72 h in gilts and sows in field condition using P.G. 450. Breen *et al*. (2006) reported weaning to estrus interval of 4 days and estrus duration of 48 h in P.G. 600 treated sows. The difference could be due to breed, climatic condition, time of treatment and dose of treatment. Previous studies demonstrated that P.G. 600 in sows at weaning induces estrus in sows within 5 days (Knox 2014, Kraeling and Webel 2015).

Reducing the dose of P.G. 600 for multiparous weaned sows did not alter the farrowing rate, live born piglets, total litter size at birth, litter size at weaning and pre-weaning mortality. In the present study, farrowing rate was 87.5% and 91.4% in group-I and group-II, respectively ($p>0.005$). Similar to our findings, Breen *et al*. (2006) reported higher farrowing rate in PG-300 treated sows as compared to P.G. 600 treated sows, however, there was no difference in total piglets born. The difference could be due to breed, climatic condition, time of treatment and dose of treatment.

In conclusion, estrus induction was 80% and 87.5% in P.G. 600 and P.G. 450 treated multiparous sows, respectively. Reducing the dose of P.G. 600 to P.G. 450 did not affect the estrus induction, farrowing rate, litter size at birth and litter size at weaning. Based on the results of this study, P.G. 450 can be used for estrus induction and synchronization in multiparous weaned sows to optimize the reproductive efficiency under Indian condition.

SUMMARY

Estrus induction and estrus synchronization with P.G. 600 to improve the reproductive performance of multiparous sows is a standard protocol. However, its non-availability in India and higher cost warrants development of new protocols without compromising the reproductive performance. The present study compared the efficacy of two different protocols for estrus induction and synchronization in multiparous sows. The sows (n=80) were randomly divided into two groups. In group-I, sows (n=40) were injected with P.G. 600 (equine chorionic gonadotropin [eCG] 400 I.U. and human chorionic gonadotropin [hCG] 200 I.U.) and in group-II, P.G. 450 (eCG 300 I.U. and hCG 150 I.U.) intramuscularly. Reproductive performance parameters, including estrus induction, treatment to estrus induction interval, estrus duration, farrowing rate, live born

piglets/litter, stillborn piglets, total piglets born/litter, litter size at weaning and pre-weaning mortality were analyzed between two groups. Estrus induction and farrowing rate were numerically higher in group-II but statistically non-significant. Treatment to estrus induction interval was 55.59 h and 55.57 h, respectively in group-I and group-II. Similarly, total litter size at birth and litter size at weaning were non-statistically higher in group-II as compared to group-I. In conclusion, the present study demonstrated that estrus induction and synchronization can be successfully achieved in multiparous sows with P.G. 450 and this will reduce the cost of hormonal treatment and optimize the reproductive efficiency in Indian condition.

ACKNOWLEDGEMENT

The present study was funded by ICAR-Mega Seed Project on Pig (OXX01916), ICAR Research Complex for NEH Region, Nagaland Centre, Jharnapani, Medziphema, Nagaland.

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