

Original paper

ESTRUS INDUCTION IN SEXUALLY MATURE GILTS WITH DIFFERENT HORMONAL TREATMENTS

*Stančić I.*¹, Bošnjak D.², Radović I.¹, Savić B.³, Gvozdić D.⁴, Stančić B.¹*

¹University of Novi Sad, Faculty of Agriculture, 21000 Novi Sad, Serbia.

²Veterinary Institute, 23000 Zrenjanin, Serbia.

³Veterinary Institute of Serbia, 11000 Belgrade, Serbia.

⁴University of Belgrade, Faculty of Veterinary Medicine, 11000 Belgrade, Serbia.

*Corresponding author: dr.ivan.stancic@gmail.com

Abstract

The aim of this study was to determine the effectiveness of the synchronized estrus induction in sexually mature gilts, after treatment with different hormonal treatments, given in the unknown phase of a spontaneous estrus cycle. Sexually mature gilts were used, with at least one spontaneous estrous cycle. A total of 90 gilts were treated with single i/m injection of 1,000 IU eCG (Folligon[®]), 40 gilts were treated with two separate i/m injection of 1 ml PGF_{2α} (Dinolitic[®]), at an interval of 11 days, and 40 gilts were treated orally (within diet) with 20 mg of synthetic progestagen preparation Altrenogest (Regumate[®]), during 18 days. Estrus was detected twice daily, in the 10h to 12h intervals, by direct contact with the teaser boar. The best induction of synchronized estrus (in 90% of gilts), which appeared within the first 7 days (mean 5.3 days) after treatment, was found in gilts treated with progestagen preparations. In the three repetitions of treatment with eCG, within the first 7 days (mean 4.2 days) after the treatment, estrus was detected in 65%, 40% or 33% of the treated gilts. After treatment with luteolytic preparation PGF_{2α} (Dynolitic[®]), estrus was detected in 40% of gilts, on average 5.5 days after treatment. The obtained results clearly show that the successful induction of synchronized estrus in sexually mature gilts can be done only by the method for prolongation of the luteal phase of the spontaneous estrous cycles, using progestagen preparations.

Key words: *estrus, gilt, hormones, induction, treatment*

Introduction

In the intensive pig production, it is often necessary to induce synchronized estrus, for a number of sexually mature gilts (Gordon, 2005; Stančić, 2005). The goal is to get all the treated gilts at the beginning of the follicular phase (proestrus) of the induced estrous cycle, after cessation of treatment. In general, the induction of synchronized estrus in sexually mature gilts can be done by the control of spontaneous cycles luteal phase duration, using different hormone preparations (Stančić, 2002; Coffey et al., 2002; Cassar, 2009; Brüssow and Wähler, 2011). Luteal phase of the spontaneous estrous cycles can be either shortened by

using luteolytic preparations (native or synthetic PGF_{2α} preparations) or prolonged by using synthetic progestagen preparations, as well as by regression accessory corpora lutea (with a single PGF_{2α} injection), induced by a single injection of gonadotropin eCG (Stančić et al., 1998; Estill, 2000; Flowers, 2001; Marić et al., 2003; Estienne, 2003; Stančić et al., 2007; Bošnjak, 2007; Davis, 2008; Stančić, 2010; De Rensis et al., 2012; Stančić et al., 2013). However, the success of the degree of estrus synchronization depends on the phase of the spontaneous estrous cycle of the gilts at the treatment beginning, as well as on the applied hormonal preparations. In the practical conditions, most often, the phase of spontaneous estrous cycle in gilts at the start of hormonal treatment is unknown. This results in a highly variable success of synchronized estrus induction, depending on the applied hormone preparations (Stančić, 2005; Gordon, 2005; Stančić et al., 2013).

Therefore, the aim of this study was to determine the degree of synchronized estrous response in sexually mature gilts treated with various hormonal preparations (gonadotropins, prostaglandin F_{2α} and progestagens) in an unknown stage of spontaneous estrous cycle.

Materials and methods

Farm. Investigations were carried out on an intensive pig production farm in AP Vojvodina, Serbia. For the experiment we used gilts of 7 to 8 months of age, 125 to 140 kg body weight, in which at least one spontaneous estrous cycle was detected. Detection of estrus was performed twice daily at an interval from 10h to 12h, by full contact with the teaser boar. The experimental gilts were housed in group pens, with the possibility of individual nutrition. Gilts were treated in an unknown stage of spontaneous estrous cycle, using gonadotropin (eCG - equine chorionic gonadotropin), luteolytic (PGF_{2α}) or synthetic progestagen (Altrenogest) hormonal preparations.

Gonadotropin treatment. A total of 90 gilts (30 gilts per group, for three treatment replications) was treated with gonadotropin preparation eCG (Folligon[®], Intervet - Boxmer, Holland). The treatment was performed by a single i/m injection of 1,000IU eCG.

Luteolytic treatment. Prostaglandin F_{2α} preparation (PGF_{2α}) Dynolitic[®] (Phizer) was used as a luteolytic hormone for gilts treatment. A total of 40 gilts was treated by two separate i/m injections of 1ml Dynolitic solution (containing 5mg Dinoprost), within an interval of 11 days.

Progestogen treatment. Preparation Regumate[®] (Roussel Uclaf, Bernburg, Germany) was used. The active substance of the preparation is Altrenogest, highly potent synthetic analogue of progesterone. Each gilt (n=40) received 5ml Regumate daily, containing 20mg Altrenogest, for 18 days. The preparation was applied by the original spray bottle, directly into the individual gilts morning part of daily meal, just before consumption, so each gilt consumed the entire daily dose of preparations.

Induced estrus detection was performed as described for the detection of spontaneous estrus, starting about 24h after the cessation of the hormonal treatments. Estrus which appeared within the first 7 days after treatment was considered to be induced by hormonal preparations (Gordon, 2005; Stančić, 2005).

Results and discussion

The experimental results are shown in Table 1. The degree of synchronized induced estrous reaction in gilts, within the first 7 days after treatment with gonadotropin preparation eCG, was highly variable among the three treatment groups (63%, 40% and 33%). The average interval from the end of treatment to the occurrence of induced estrus was 4.2 days (3 to 6 days). Total estrous response, in this group of gilts, was high (93%, 83% and 97%), but the average interval from the end of treatment to estrus, was much longer (lasting 24 to 27 days).

On average 5.5 days (4 to 7 days) after second luteolytic (PGF_{2α}) injection, synchronized estrus was induced in only 40% of treated gilts. Total estrus reaction was high (90%), with an average interval of 11.2 days (8 to 15 days) from the second PGF_{2α} injection to estrus detection.

Progestagen treatment resulted in high proportion of synchronized estrus induction (90% of treated gilts). On average, induced estrus was detected 5.3 days (4 to 7 days) after cessation of treatment. In the remaining four gilts (10%) estrus was not detected within 30 days after cessation of treatment with progestagen.

Table 1. *Estrus reaction in sexually mature gilts after different hormonal treatments*

		Hormonal treatments		
		eCG	PGF _{2α}	Progestagen
Gilts treated, n		30 ¹ , 30 ² , 30 ³	40	40
Average gilts age at the start of treatment, days		218 (205-234)	231 (212-240)	223 (210-238)
Gilts with detected estrus within 7 days after treatment*	n	19 ¹ , 12 ² , 10 ³	16	36
	%	63 ¹ , 40 ² , 33 ³	40.0	90.0
Average interval from the end of treatment to induced estrus, days		4.2 (3-6)	5.5 (4-7)	5.3 (4-7)
Total gilts with detected estrus	n	28 ¹ , 25 ² , 29 ³	36	36
	%	93 ¹ , 83 ² , 97 ³	90.0	90.0
Average interval from the end of treatment to estrus in the total gilts with detected estrus, days		24 ¹ , 26 ² , 25 ³ (24-27)	11.2 (8-15)	5.3

* Estrus induced by hormonal treatment. ^{1,2,3} First, second and third treatments.
Minimal and maximal values in parenthesis.

The results of our study clearly show that there is a considerable variation in the degree of synchronized estrous response after treatment performed with various hormonal preparations, in the unknown phase of a spontaneous estrous cycle of gilts. Thus, within 7 days after treatment with placental gonadotropin eCG, in the three groups of gilts, estrus was detected in 63%, 40% or 33% of the treated gilts. In the same interval after treatment with luteolytic preparation PGF_{2α}, estrus was detected in 40% treated gilts. Higher degree of synchronized estrous reaction was found after treatment with progestagen preparations. Namely, within 7 days after cessation of treatment, estrus was detected in 90% gilts. The interval from the end of treatment to the appearance of induced estrus was similar (average 4.2 to 5.5 days), regardless of the used hormonal preparations.

Synchronized ovulation can be induced by placental (eCG and hCG) or pituitary (FSH and LH) gonadotropic hormone preparations in sexually immature (prepubertal, acyclic) and sexually mature (pubertal, cyclic) gilts, as well as in weaned sows (Flowers, 2001; Stančić,

2005; Tummaruk et al., 2011; Brüssow and Wähler, 2011). Prepubertal gilts and weaned sows respond with very high proportion of synchronized estrus, within 4 to 6 days after a single injection of 500 to 1,500 IU eCG. This effect is achieved due to the fact that, at the moment of treatment, only follicles with non-functional corpora lutea (CL) are present at ovaries of both females category (Stančić et al., 1998; Coffey et al., 2002; Gordon, 2005; Stančić et al., 2007; Cassar, 2009). In 80 % to 100 % of sexually mature gilts, eCG injection given at any stage of spontaneous estrous cycle causes a synchronized ovulation and formation of functional accessory corpora lutea. However, the synchronized estrus, within 4 to 6 days after the eCG, occurs only in the gilts treated during the follicular phase or at the end of the luteal phase of spontaneous cycles. This is due to the inhibitory action of the induced (accessory) and spontaneous estrus cycles corpora lutea. Therefore, the degree of synchronization of estrus is highly variable in sexually mature gilts treated at an unknown stage of spontaneous estrous cycle, depending on the proportion of gilts in certain phases of spontaneous estrous cycle at the moment of eCG treatment (Ramapacek et al., 1992; Heavenly et al., 1997; Haff et al., 2002; Stančić, 2005; Bošnjak et al., 2007; Stančić et al., 2012; Stančić et al., 2013).

The injection of PGF_{2α}, within the first 12 days of the luteal phase of the spontaneous estrous cycle does not cause regression of corpora lutea (CL). This is due to the fact that the pigs CL, unlike cows CL, are responsive to the luteolytic action of PGF_{2α} only within the last 4 days of the luteal phase, ie. after day 12 of diestrus (Guthrie and Polge, 1976; Guthrie, 1979; Puglisi et al., 1979; Stančić, 1979; Stančić and Vuković, 1995; Stančić et al., 1998; Stančić et al., 2007). Therefore, there is a high probability that a large number of gilts, at the moment of PGF_{2α} treatment, are not in the reactive phase of spontaneous estrus cycle (follicular and first 12 days of luteal phase). Such gilts will not react with CL regression, and with synchronized estrus manifestation. The result is low degree of estrus synchronization after PGF_{2α} treatment of gilts in the unknown stage of spontaneous estrous cycle (Stančić et al., 1995; Almond, 1997; Nebesni et al., 1997; Stančić et al., 1998; Stančić, 2010; De Rensis et al., 2012).

The highest level of synchronized estrus in sexually mature gilts can be achieved by peroral treatment with synthetic progestagen preparations (Davis et al., 1979; Almond, 1997; Stančić et al., 2005). Recently, the most commonly used preparation has been Altrenogest (Regumate[®]) for 16 to 18 days peroral treatment. After such treatment, synchronized estrus occurs 4 to 7 days after cessation of treatment in 80% to 100% of gilts (Estienne et al., 2001; Estienne and Harper, 2002; Marić et al., 2003; Gordon, 2005; Stančić, 2005; Stančić et al., 2007; Bošnjak et al., 2007; Stančić, 2010).

The results of the present study and the results of other authors clearly demonstrate that a high degree of estrus synchronization in sexually mature gilts can only be achieved by applying treatment with progestagen preparations. Treatment of these gilts with gonadotropin or luteolytic hormonal preparations is not effective and has no relevance to the practical application for estrus synchronization in sexually mature gilts.

Conclusion

Based on the obtained results, we can conclude the following:

1. The degree of synchronized estrous response in sexually mature gilts significantly varies depending on the applied hormonal preparations (gonadotropins, luteolytics or

progestagens) and the phase of the spontaneous estrous cycle in which the treatment is carried out.

2. Within the first 7 days after treatment, estrus was detected in 33% to 63% gilts treated with gonadotropin eCG (Folligon[®]), in 40% gilts treated with luteolytic PGF_{2α} (Dynolitic[®]), and in 90% gilts treated with progestagen preparation (Regumate[®]).
3. Synchronized estrus in high proportion of sexually mature gilts can only be achieved by progestagen treatment. Treatment with gonadotropin or luteolytic hormonal preparations is not effective and has no relevance to the practical application for estrus synchronization in sexually mature gilts.

References

1. Almond WG 1997. Synchronization of estrus in gilts 1997. Proc. North Carolina Hweakthy Hogs Seminar, UK, 1-3 pp.
2. Bošnjak D, Stančić B, Pejin B, Đurđević I and Timotijević M 2007. Estrusno reagovanje dugotrajno anestričnih nazimica, posle tretmana preparatom «Regumate» ili PMSG. Simpozijum «Veterinarska medicina, stočarstvo i ekonomika u proizvodnji zdravstveno bezbedne hrane». Herceg Novi, Serbia, 119 pp.
3. Brüßow K-P and Wähner M 2011. Biological and technological background of estrus synchronization and fixed-time ovulation induction in the pig. *Biotechnology in Animal Husbandry*, 27, 533-545.
4. Cassar G 2009. Hormonal Control of Pig Reproduction. London Swine Conference – Tools of the Trade, UK, 1-9 pp.
5. Coffey DR, Parker RG and Laurent MK 2002. Manipulation of the Estrus Cycle in Swine. *Agric Educ ASC-152*, 1-7.
6. Davis LD, Knight WJ, Killian BD and Day NB 1979. Control of estrus in gilts with a progestogen. *J Anim Sci* 49,1506-1509.
7. Davis LD 2008. Using Regumate to Control Estrus in Swine. Swine Day Report of Progress 940, Kansas State University, USA, 11-15 pp.
8. De Rensis F, Saleri R, Tummaruk P, Techakumphu M and Kirkwood RN 2012. Prostaglandin F_{2α} and control of reproduction in female swine: a review. *Theriogenology* 77, 1-11.
9. Estienne JM and Harper FA 2002. Synchronization of Estrus and Fertility in Gilts Administered P.G. 600[®] After Treatment with Regu-mate[®] for 14 or 18 Days. *The Professional Animal Scientist* 18,158–161.
10. Estienne JM, Harper FA, Horsley RB, Estienne EC and Knight WJ 2001. Effect of P.G.600 on the onset of estrus and ovulation rate in gilts treated with Regumate. *J Anim Sci* 79, 2757-2761.
11. Estienne M 2003. A Newly Available Tool for Synchronization of Estrus in Swine. Virginia Cooperative Extension, Livestock, USA, 1-6 pp.
12. Estill TC 2000. Current concepts in estrus synchronization in swine. *J Anim Sci* 77, 1-9.
13. Flowers LW 2001. Synchronization of estrus in swine. North Carolina State University, Pork Information Gateway, USA, 1-8 pp.
14. Gordon I 2005. Reproductive Technologies in Farm Animals. CAB Int. Publ. Oxfordshire, UK.

15. Guthrie DH and Polge C 1976. Luteal function and oestrus in gilts treated with a synthetic analogue of prostaglandin $F_{2\alpha}$ (ICI 79,939) at various times during the oestrous cycle. *J Reprod Fert* 48, 423-425.
16. Guthrie DH 1979. Fertility after estrous cycle control using gonadotropin and prostaglandin $F_{2\alpha}$ treatment of sows. *J Anim Sci* 49, 158-162.
17. Haff ten W, Thacker AP and Kirkwood NR 2002. Effect of injecting gonadotrophins during the luteal phase of the estrus cycle on the inter-estrus interval of gilts. *Can J Anim Sci* 82, 457-459.
18. Marić Z, Stančić B and Gagrčin M 2003. Sinhronizacija estrusa u polno zrelih nazimica primenom preparata Regumate. *Savremena poljoprivreda* 52, 219-224.
19. Nebesni A, Stančić B and Šahinović R 1997. Ovarian reaction in gilts treated with PMSG at different time after standing oestrus. *Proc. 3rd Symp. Anim. Reprod. Macedonia, Ohrid*, 92 pp.
20. Puglisi TA, Rampacek GB, Kraeling RR and Kiser TE 1979. Corpus luteum susceptibility to prostaglandin $F_{2\alpha}$ (PGF $_{2\alpha}$) luteolysis in hysterectomized prepubertal and mature gilts. *Prostaglandins*, 18, 257-264.
21. Rampacek GB, Kraeling RR, Barb CR, Estienne CE and Estienne MJ 1992. Regression of induced corpora lutea in mature cyclic gilts by human chorionic gonadotropin. *J Anim Sci* 70, 3144-3148.
22. Stančić LB 2005. Reprodukcijska svinja (monografija). Univerzitet u Novom Sadu, Poljoprivredni fakultet.
23. Stančić B, Gagrčin M, Stanković A and Budinčević A 1998. Primena egzogenih hormona u sinhronizaciji estrusa nazimica. *Veterinarski glasnik* 52, 129-132.
24. Stančić B, Radović I, Stančić I and Gagrčin M 2007. Sinhronizacija estrusa i fertilitet nazimica tretiranih različitim hormonskim preparatima. *Savremena poljoprivreda* 56, 8-13.
25. Stančić B and Vuković M 1995. Sinhronizacija estrusa i superovulacije u nazimica primenom prostaglandina i gonadotropina (abstrakt). VIII Savetovanje veterinarara Srbije. Zlatibor, Srbija, 128 pp.
26. Stančić B 1979. Neka razmatranja o mogućnosti primene prostaglandina $F_{2\alpha}$ i njegovih sintetičkih analoga u regulaciji reproduktivnog procesa svinje i goveda. *Veterinaria* 28, 127-131.
27. Stančić I, Bošnjak D, Radović I, Gvozdić D, Savić B and Stančić B 2013. Fertility of gilts with prolonged preinsemination anestrus after progestagen-eCG treatment. *Slov Vet Res* 50, 111-116.
28. Stančić I 2010. Indukcija estrusa i fertilitet nazimica sa prolongiranom preinseminacionom anestrijom, tretiranih preparatima gonadotropina i progestina. PhD, Univerzitet u Novom Sadu, Poljoprivredni fakultet.
29. Stančić LB 2002. Biotechnology in swine reproduction: A review of our investigations. *Buletinul Univ Sci Agric Med Vet Cluj (Romania)* 57, 232-234.
30. Stančić BI, Bošnjak VD, Radović BI, Stančić LB, Harvey BR and Anderson CR 2012. Ovarian reaction and estrus manifestation in delayed puberty gilts after treatment with equine chorionic gonadotropin. *Reproductive Biology and Endocrinology* 10, 61.
31. <http://www.ncbi.nlm.nih.gov/pubmed?term=Stancic%20IB>
32. Tummaruk P, Athaporn Roongsitthichai A and De Rensis F 2011. Ovulation Induction in Swine. *Thai J Vet Med Suppl* 41, 19-23.