

EFFECT OF PROSTAGLANDIN F2 α ON REPRODUCTIVE PERFORMANCE IN RABBIT DOES

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Abstract

The aim of the study was to test the effectiveness of oestrus synchronization with prostaglandin F2 α (PGF2 α) and PMSG in rabbit does. A total of 1200 commercial hybrid rabbit does (nulliparous, primiparous lactating and multiparous lactating) were randomly divided into two groups and treated as follows: experimental group, 20 IU of PMSG i.m. + 0.5 mg dinoprost, a synthetic analogue of PGF2 α ; control group, 20 IU PMSG i.m. Fifty-four hours after treatment all the does were inseminated. Fertility and litter size were not significantly influenced by PGF2 α treatment in nulliparous does. PGF2 α treatment had no effect on the fertility of primiparous does, which was 82% in the experimental and 80% in the control group. Fertility of multiparous does was about 6% higher in the experimental compared to the control group ($P \leq 0.05$). PGF2 α improved litter size in primiparous (non-significantly) and multiparous does ($P \leq 0.01$). The results of this study show that simultaneous treatment with PGF2 α and PMSG used for oestrus synchronization can increase reproductive performance in postpartum rabbit does.

Key words: rabbit, oestrus synchronization, PGF2 α , reproductive performance

Artificial insemination of rabbit does was introduced to European farms in the late 1980s. This reproductive technology enabled the development of a new cycled production system and a better organization of farms. One of the most important aspects of artificial insemination (AI) is the possibility of inseminating female rabbits regardless of their oestrus phase. This fact can be considered as positive, but in view of the fixed cycle of production, the irregular alternation of oestrus and anoestrus periods, which strongly influences reproductive performance, is disadvantageous. Three categories of does with different reproductive responses can be defined: nulliparous, primiparous and multiparous. Many studies (Bourdillon et al., 1992; Theau-Clemant and Lebas, 1994; Davoust et al., 1994) concur that while nulliparous does generally show good performance (high fertility rate, medium litter size), primiparous does inseminated during lactation give poor results. Fertility rate of multiparous lactating does is intermediate between nulliparous and primiparous, while litter size is gener-

ally higher. The improvement and homogenization of reproductive performance on farms are conditioned by the use of methods enabling the induction and synchronization of oestrus. This concerns hormonal treatments or non-hormonal alternative methods. Hormonal treatments have been widely used in recent years. With these treatments, different types and dosages of hormones are administered before insemination. Oestrus synchronization by means of PMSG injection two or three days before insemination has become very common in industrial management, as this practice generally improves reproductive performance and is simple to use (Bonnano et al., 1991; Castellini et al., 1991; Bourdillon et al., 1992; Angeli et al., 1999; Gogol, 2004). PMSG is a glycoprotein extracted from the serum of pregnant mares and has a hormonal follicle stimulating and luteinizing action. In contrast, several authors have suggested using prostaglandin F₂ α (PGF₂ α) to improve doe receptivity and to prepare the animals better for AI Facchin et al. (1992), who used PGF₂ α 64 hours before AI for oestrus synchronization of multiparous does, showed a positive effect on the performance compared to the PMSG treated group. In a comparable trial Alvarino et al. (1995) observed that PGF₂ α improved the fertility rate in nulliparous and multiparous inseminated does. In contrast, when PGF₂ α was injected 72 hours before insemination, Mollo et al. (2003) did not observe an increase of fertility. Under the same conditions Stradaoli et al. (1993) did not improve the ovarian response (ovary weight, number of corpora lutea and haemorrhagic follicles) nor the ability of early embryos to develop *in vitro*.

The aim of the study was to test the effectiveness of oestrus synchronization with PGF₂ α and PMSG in improving reproductive performance in rabbit does.

Material and methods

Animals

This experiment was carried out from October to December in a breeding farm in which controlled light-dark cycles (8h light: 16h dark) were applied. A total of 1200 commercial hybrid rabbit does were used. They were clinically healthy and were in different "physiological states" defined by the combination of parity and state of lactation (nulliparous, primiparous-lactating, multiparous-lactating). The does were housed in individual metal cages with external nest boxes and had free access to commercial pelleted food and water. Eight days before AI the lighting regime was changed from 8 to 16 hours per day. One day before AI nursing was prevented and nests were reopened immediately after insemination. Litters from lactating does were standardized on day 1 after parturition to 8–9 by adding or removing pups. A 45-day reproduction rhythm was followed. Free suckling and weaning at 35 days of age was adopted.

Treatments

Does of each category (nulliparous, primiparous-lactating, multiparous-lactating) were randomly divided into two groups. They were treated in the following manner:

– experimental group: 20 IU of PMSG i.m. (Folligon, Intervet, The Netherlands) + 0.5 mg dinoprost, a synthetic analogue of prostaglandin F2 α (PGF2 α) (Dinolytic, Pharmacia, Belgium),

– control group: 20 IU of PMSG i.m. (Folligon, Intervet, The Netherlands).

Fifty-four hours after treatment, on day 15 postpartum in lactating does, all the does were inseminated. Artificial insemination was performed by depositing 0.5 ml of fresh semen deeply in the vagina by means of sterile catheter. A pool of sperm, collected from bucks of proven fertility was used. Semen was diluted with a commercial extender (Galap, IMV, France) stored at 20°C and used within 4 hours of collection. The insemination was immediately followed by the administration of 0.8 μ g of busserelin i.m. (Receptal, Hoechst, Germany) in order to induce ovulation. At parturition, the fertility rate (number of parturitions/number of inseminations \times 100) and the total number of young born (litter size) were recorded.

Statistical analysis

A Chi-square test was used to analyse the fertility data. Data relating to the prolificacy were evaluated by ANOVA, and the significance of differences between means was tested using Student t-test.

Results

In nulliparous does fertility and litter size were not significantly influenced by PGF2 α treatments (Table 1). PGF2 α treatment had no effect on fertility of primiparous does (Table 2), which was 82% in the experimental and 80% in the control group. Fertility of multiparous does was about 6% higher in the experimental than in the control group ($P \leq 0.05$) (Table 3). The simultaneous treatment with PGF2 α and PMSG improved litter size in primiparous (non-significantly) and multiparous does ($P \leq 0.01$).

Table 1. Effect of PGF2 α treatment on fertility and litter size (total born) of nulliparous does

Item	PMSG+PGF2 α	PMSG	Significance level
No. of inseminated does	80	80	-
Fertility (%)	82.50	88.75	NS
Litter size ($\bar{x} \pm$ SD)	9.06 \pm 1.94	9.07 \pm 1.98	NS

NS – non-significant.

Table 2. Effect of PGF2 α treatment on fertility and litter size (total born) of primiparous lactating does

Item	PMSG+PGF2 α	PMSG	Significance level
No. of inseminated does	50	50	-
Fertility (%)	82.00	80.00	NS
Litter size ($\bar{x} \pm$ SD)	10.93 \pm 2.32	10.07 \pm 2.40	NS

NS – non-significant.

Table 3. Effect of PGF2 α treatment on fertility and litter size (total born) of multiparous lactating does

Item	PMSG+PGF2 α	PMSG	Significance level
No. of inseminated does	470	470	
Fertility (%)	80.00	74.04	x
Litter size ($\bar{x} \pm SD$)	11.35 \pm 2.29	10.65 \pm 2.74	xx

x – P \leq 0.05; xx – P \leq 0.01.

Discussion

Our results show that the simultaneous treatment with PMSG and PGF2 α improved reproductive performance in lactating multiparous and primiparous but not nulliparous does. The results obtained agree with the findings of Facchin et al. (1992), Alvarino et al. (1995), Facchin et al. (1998) and Alaphilippe and Bernard (1998), who reported that PGF2 α administration to does inseminated after parturition improves reproductive performance. Although the physiological basis of these results is still unclear, the improvement of reproductive performance suggests that PGF2 α may have some relevant physiological role. One of the most frequently cited hypotheses relies on the luteolytic effect of PGF2 α acting on pseudopregnant does. Thus, PGF2 α leads to the regression of existing corpora lutea and consequently withdraws the inhibition of progesterone notably on oestrogen secretion, therefore allowing a new reproductive cycle. The simultaneous treatment with PMSG and analogues of PGF2 α demonstrated by Facchin et al. (1998) supports this hypothesis. These authors observed that the combination of PMSG and PGF2 α increases the fertility whereas the percentage of pseudopregnant does at the moment of AI decreases. PGF2 α may have an indirect action only on pseudopregnant does, whereas PMSG has a direct action on the ovaries (an increase of follicle growth). These two hormones could thus be complementary on a herd that, for reason not yet well understood, includes pseudopregnant does. Systematic progesterone measurement realized at insemination (Theau-Clement et al., 2005) showed that the frequency of pseudopregnant does (concentration of serum progesterone >1 ng/ml) depends on the parity of the does. The highest frequency of pseudopregnancy was observed in primiparous and the lowest in multiparous does. In contrast, Boiti et al. (1999) and Mollo et al. (2003) conclude, based on analysis of progesterone concentration, that spontaneous ovulation leading to pseudopregnancy occurs very rarely on farms that are well managed in terms of animal husbandry and hygiene. In such a situation, PMSG and PGF2 α used for postpartum oestrus synchronization, while not ameliorating fertility rate, can improve litter size (Mollo et al., 2003). This effect, though understandable for PMSG is difficult to explain in the case of PGF2 α . These observations as well as the results obtained in this study (improved reproductive parameters only for post partum lactating does and especially for litter size) indicate the existence of a different mechanism of action of PGF2 α .

Many data suggest that besides the luteolytic effect, PGF2 α may be involved in the ovulatory process by stimulating the enzymatic proteolytic cascade which leads to the disruption of the follicular wall (Myazaki et al., 1991). However, this physiological

role has also been modulated by many other substances including histamine, kinins, leukotrienes, and plasminogen activator, which are involved in the process (Castellini, 1996). The physiological action of PGF2 α is not obvious because rabbit does are not cyclic females and the reproductive response could be mediated by the ovary: if the doe presents different ovary situations, the effect of PGF2 α could be very different (luteolytic or luteotrophic).

The results of this study show that simultaneous treatment with PGF2 α and PMSG used for oestrus synchronization can increase reproductive performance in postpartum rabbit does. Further experiments are necessary to explain mechanisms of PGF2 α action on reproductive physiology in rabbits.

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Wpływ prostaglandyny F2 α na wyniki rozrodu królic

STRESZCZENIE

Celem badań była ocena efektywności synchronizacji rui u królic wywoływanej poprzez jednoczesne podanie prostaglandyny F2 α (PGF2 α) i PMSG. Oceniano wpływ takiego postępowania na wyniki rozrodu królic. Badania przeprowadzono na 1200 samicach hybrydowych (inseminowanych po raz pierwszy, karmiących pierwiastkach oraz wieloródkach), które podzielono na dwie grupy. W grupie doświadczalnej samicom podawano 0,5 mg syntetycznego analogu PGF2 α (dinoprost) oraz PMSG, w grupie kontrolnej tylko PMSG. Po upływie 54 godzin od podania hormonów wszystkie samice inseminowano. W grupie samic inseminowanych po raz pierwszy zastosowanie PGF2 α nie wpłynęło istotnie na płodność i liczbę młodych w miocie. Nie stwierdzono również istotnego wpływu podania PGF2 α na płodność pierwiastek. W przypadku wieloródek płodność w grupie doświadczalnej była o około 6% wyższa niż w grupie kontrolnej ($P \leq 0,05$). Podanie PGF2 α spowodowało wzrost liczby młodych w miocie u pierwiastek (różnice statystycznie istotne) oraz wieloródek ($P \leq 0,01$). Uzyskane wyniki wskazują, że jednoczesne użycie do synchronizacji rui PGF2 α i PMSG może poprawić wyniki rozrodu pierwiastek i wieloródek.