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ABSTRACT

Over a four month period (April-July, September-November 1999), the effect of flushing method to improve the reproductive parameters of rabbit does reared in an intensive system were studied. Two reproductive cycles were investigated on multiparous lactating does subjected to artificial insemination (AI). Two experimental treatments were performed: PMSG group (25 IU injected 60 hrs. before AI) and PG group (2% propylene glycol, as an energy source, administered into drinking water, during the 5 days before AI). The physiological status of does (parity order) was considered, but was not significant. Fertility and mortality rate at weaning didn't show any statistically significant differences between the treatments (60%, 65% - 6.32%, 7.54% for PG and PMSG respectively). Does treated with PG showed better weights than those treated with PMSG especially the weight at weaning (4303 g vs. 4194g). There was an important effect on daily weight gain of does from mid-lactation to weaning and from fostering to weaning ($P \leq 0.05$) and from insemination to weaning ($P \leq 0.01$). These results show that hormonal treatments could be avoided in favour of energetic dietary flushing.

INTRODUCTION

Artificial insemination and an adapted management system (*cyclization*) are used as reproduction techniques in commercial rabbit breeding. These methods require hormonal treatments. The repeated administration of gonadotrophins can cause fertility problems related to antibody production (Castellini *et al.*, 1991). It has also been shown that PMSG induces superovulation, above all in primiparous lactating does, and low embryo quality (Maertens and Luzi, 1995; Carney and Foote, 1990). The residues of pharmacological treatments, hormones and additives, are badly accepted by the consumers and the maintaining of a "natural" image becomes more and more important.

Propylene glycol (PG) is a widely used compound with diverse applications and in many commercial animals (dairy cows: Formigoni *et al.*, 1996; sows: Superchi *et al.*, 1999; pets: Christopher *et al.*, 1989). It is a polyhydric alcohol ($C_3H_8O_2$) which is a colourless, odourless liquid with mildly acrid and sweetish taste. It is freely soluble in water and ethanol. It has been extensively employed in the pharmaceutical industry as a solvent for drugs, as stabiliser for vitamins and in pastes for medicinal purposes. Propylene glycol is commonly used as a vehicle for drugs with poor water solubility and its toxicity in drug forms given *per os* or intravenous is low (Seidenfeld & Hanzlik, 1932). The following acute oral LD_{50} values have been found for rabbits: 18 mg/kg of body weight (*per os*), 6 mg/kg of body weight (intramuscular) and 5 mg/kg of body weight (intravenous) (Ruddick, 1972).

The objective of the present trial is to evaluate the benefits of an alternative synchronising method under farm conditions. To induce oestrus in rabbit does, because of its low toxicity and lack of studies in rabbits, we utilised a flushing method with 2% propylene glycol (1,2-propanediol) in the drinking water.

MATERIAL AND METHODS

Farm and management

The trial, which ran in two steps, was carried out on an industrial rabbit farm in the North - East of Italy (April-July; September-November 1999). The rabbitry was force ventilated and the industrial hybrid does were individually housed in flat-deck cages (40x90x28 cm). The commercial feed (crude protein 16.5%; crude fibre 15.3%, crude fat 3.0%) was administered *ad libitum* and automatically distributed.

Animals and experimental treatments

Three hundred sixty multiparous hybrid does (1^{st}-15^{th} parity order) were submitted to two semi-intensive reproductive cycles (11-12 days *post partum*), utilising the artificial insemination technique (A. I.). Two different systems to induce oestrus were analysed:
- item 1 (167 does) - hormonal treatment by PMSG, 25 I.U./doe, 60 hours before artificial insemination.
- item 2 (165 does) - PG treatment, 2% in drinking water, continuously for five days before A.I.

All does were treated with GnRH (0.8 ng of active principle) to induce ovulation immediately after artificial insemination.

Animal performance

Does were weighed individually before A. I., before fostering (3 days *post partum*), during lactation (19 days *post partum*) and before weaning (33 days *post partum*). Parity order was divided in the following classes:
- class 1 (1^{st} and 2^{nd} parity order);
- class 2 (3^{rd}, 4^{th}, 5^{th} parity order);
- class 3 (from 6^{th} to 9^{th} parity order);
- class 4 (from 10^{th} to 15^{th} parity order).

The daily weight gain (DWG) of does was studied in the following periods, taking account of the pregnancy status (positive or negative palpation):
- DWG 1 (from insemination to litter fostering);
- DWG 2 (from fostering to mid-lactation);
- DWG 3 (from mid-lactation to weaning);
- DWG 4 (from fostering to weaning);
- DWG 5 (from insemination to weaning)

The total number of kits born and born alive, the litter size during lactation and at weaning were evaluated. Litters were weighed and the daily weight gain was recorded according to the following scheme:
- nest DWG 1 (from fostering to mid-lactation);
- nest DWG 2 (from mid-lactation to weaning);
- nest DWG 3 (from fostering to weaning).

Furthermore, fertility (kindling rate) and mortality rate at weaning were recorded. At the end of the study, a sample of animals from each experimental group was sacrificed to evaluate the PG residues in the meat, kidney, liver and lung, by gas chromatographic analysis (Kaijwara *et al*., 1981).

Statistical analysis

Reproductive and productive data were analysed in a randomised design by the GLM procedure (SAS/STAT, 1990) with treatment and parity class as main sources of variation, according to the following model:

$Y_{ijh} = \mu + \alpha_i + \beta_j + \gamma_{ijk} + \varepsilon_{ijkh}$

Y_{ijk} = dependant variable;

μ = general mean;

α_i = fixed effect of treatment (i =1,2);

β_j = fixed effect of the parity class (j = 1…4);

γ_{ijk} = nested effect between treatment and parity class

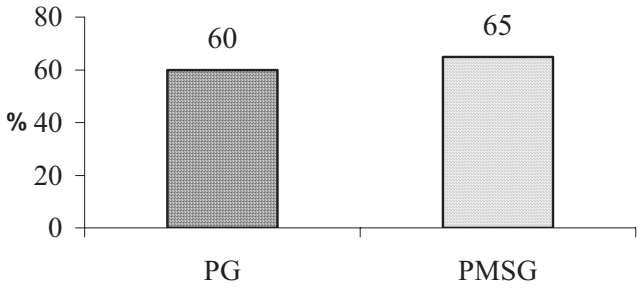
ε_{ijkh} = random effect.

The mortality rate at weaning and the fertility rate according to the treatments were studied using the χ^2 test (SAS/STAT, 1990).

RESULTS AND DISCUSSION

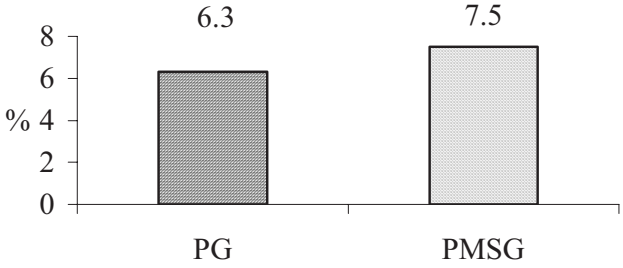
Fertility rate at birth did not show any statistical differences between treatments although the PMSG group had the higher value (65%) compared to the PG group (60%) (Figure 1).

Figure 1 - Fertility rate according to the treatments



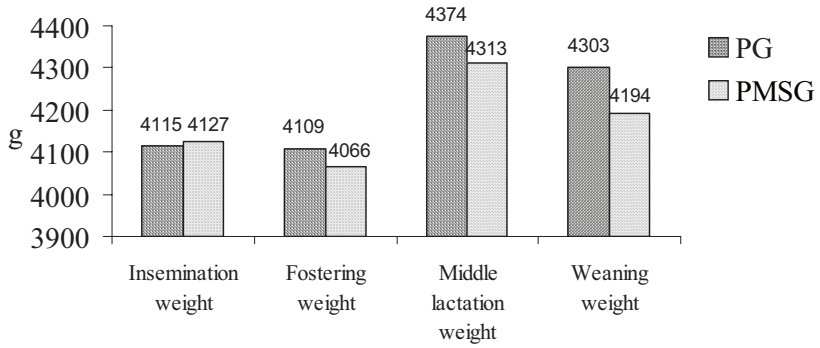
Mortality rate at weaning did not show any statistically significant effects between treatments. The PMSG group had a higher mortality rate than the PG group (7.5% and 6.3%, respectively) (Figure 2).

Figure 2 - Mortality rate at weaning according to the treatments



Doe weights related to treatments are shown in Figure 3. During the trial, does treated with PG showed better values than the PMSG treated does, especially the weight of does at weaning (4303 g vs 4194g).

Figure 3 - Weight of does according to the treatments



The results related to does and litter daily weight gain, according to the treatments are shown in Table 1. Propylene glycol had a more positive effect on DWG3 and DWG4 ($P \leq 0.05$) and total daily weight gain ($P \leq 0.01$) than PMSG.

Table 1 - Daily weight gain (g) (mean ±SE) of the does and litter according to the treatments

	PG	PMSG
N°	165	167
DWG 1	-0.28±0.75	-0.83±0.71
DWG 2	18.67±1.41	17.54±1.35
DWG 3	-4.77±1.38 b	-9.25±1.32 a
DWG 4	6.32±0.82 a	3.93±0.79 b
DWG 5	2.62±0.46 A	0.97±0.44 B
nest DWG 1	15.85±1.15	16.76±1.11
nest DWG 2	38.65±1.47	36.85±1.41
nest DWG 3	26.12±0.34	25.68±0.33

Means in the same row with different small letters were different ($P \leq 0.05$); those with differing capital letters were different at $P \leq 0.01$.

During the period from mid-lactation to weaning (DWG3), PG treated does lost 4.5 g less than PMSG treated ones. This could be related to an improved energetic balance during the whole lactation. This improvement is also shown in the fostering to weaning (DWG4) and total (DWG5) period. In fact, in the former, PG treated does increased about 2.5 g and in the latter 1.7 g faster than PMSG does. The PG treatment was responsible for better body condition and a higher fertility rate (>20%) at the next pregnancy diagnosis.

There were no significant effects of the treatments in relation to parity.

There were no propylene glycol residues in meat, liver, kidney and lung after providing at 2% in drinking water. Propylene glycol had a lower cost than the hormonal treatment. A dose of 2% PG in drinking water and a dose of PMSG cost 0.15 and 0.42 *euro* respectively, yet gave the same performance.

In conclusion, the results of this biostimulation trial are very promising and bring an alternative to hormonal induced oestrus**.** These methods will become more and more utilised in industrial rabbit farms because they are easy to apply, inexpensive and consistent with animal welfare. (Theau-Clément *et al.,* 1998; Luzi *et al.*, 1999). Animal husbandry research should study these items more deeply to produce an animal able to satisfy public opinion.

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