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EFFECT OF A 48-HOUR DOE-LITTER SEPARATION ON PERFORMANCE OF FREE OR CONTROLLED NURSING RABBIT DOES

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ABSTRACT

The effectiveness of oestrus synchronisation by 48-hour doe-litter separation (DLS) was evaluated in relation to the nursing system, free (FN) or controlled (CN). During 9 months, initially 140 NZW does, homogeneously distributed in four groups, were artificially inseminated according to a 42-day reproduction rhythm in two batches. The treatments were as follows: FN, DLS (A); FN, control (B); CN, DLS (C); CN, control (D). Without DLS, CN does showed a higher fertility in comparison with FN does (68.3 *vs* 46.6%, P≤0.05). CN reduced young losses from birth to day 9, especially on DLS groups (7.4 *vs* 11.4%, P≤0.01), but it increased the doe replacement rate and the cases of mastitis. DLS applied on FN does improved receptivity (74.2 *vs* 53.7%, P≤0.05) and fertility (69.2 *vs* 46.6%, P≤0.05), while the effect of DLS was less pronounced on fertility of CN does (77.2 *vs* 68.3%). DLS significantly reduced rabbit losses from day 9 to weaning for both suckling systems. An effect of DLS in reducing the weaning weight of rabbits was detected only on does in their second or higher lactation (-43 g, P≤0,01), regardless of suckling system. The weight recorded on day 71, during the fattening period, was lower in DLS rabbits than the control in the FN groups (2042 *vs* 2085 g, P≤0.01), but the relative difference (-2.1%) is not very important in terms of productivity.

INTRODUCTION

At present, one of the risks connected to the use of exogenous hormones in rabbit reproduction management is to damage the natural quality of rabbit meat and to interfere with animal welfare. A temporary doe-litter separation (DLS) is one of the so-called bio-stimulation techniques studied by the International Rabbit Reproduction Group (IRRG) (Boiti, 1998) to find an easy and effective alternative to hormonal treatments for inducing sexual receptivity, and to improve fertility and global productivity of lactating does (Theau-Clement *et al.*, 1998; Theau-Clement and Boiti, 1998).

In most of the IRRG experiments, DLS was performed on free nursing rabbit does immediately before an 11-day *post partum* artificial insemination. Under these conditions, a 24-hour separation did not always cause a significant increase in fertility (+3.5%, Alvariño *et al*., 1998; +12.6%, Theau-Clement and Mercier, 1999), whereas a DLS lasting from 36 to 48 hours was always effective to improve fertility of lactating does (10.5%, Alvariño *et al*., 1998; +11.1%, Maertens, 1998; +19.8%, Virag *et al*., 1999). Only a few papers studied a 48-hour DLS applied on controlled nursing does, showing a less pronounced fertility improvement (+8.4%, Bonanno *et al.*, 1999; +6.7%, Szendro *et al.*, 1999). The hypothesis that the controlled suckling, acting as a regular DLS, could limit the effect of a longer separation was advanced by Szendro *et al*. (1999).

Moreover, a slight 30 to 70 g reduction in weaning weight of rabbits separated from their dam was observed in all of the above cited works, without respect to the nursing system. In all cases, the pre-weaning survival of young rabbits was not affected. The available results thus do not allow comparisons of the influence of the suckling system on the productive response of does and their litters when DLS is applied. This experiment was conducted within the IRRG to ascertain the effects of the nursing system (free or controlled) on performance of lactating does and their litters when submitted to a 48-hour separation before insemination.

MATERIALS AND METHODS

Animals and housing.
The experiment was carried out on a commercial rabbit farm in Sicily between December 1998 and August 1999. Initially 140 New Zealand White does were homogeneously and definitively distributed in four experimental groups (A, B, C, D), on the basis of their physiological status (lactating and non-lactating) and parity at the first artificial insemination (AI). Does removed were immediately replaced by young does. Eight Burgundy Fawn bucks were used for AI. The does were housed in flat-deck cages with internal, isolatable nestboxes under a light program of 16 hours per day, and fed *ad libitum* with a commercial diet (18.9% CP and 15.5% CF on a d.m. basis).

Reproduction rhythm and treatments. A 42-day reproduction rhythm was followed, using 2 batches of does inseminated with a 21-day interval. Non-pregnant does were inseminated again 21 days later. The does were subjected to one of the following treatments, in relation to their initial group:

A. free nursing; 48-hour doe-litter separation (DLS) by closing the nestbox before AI, from 10 a.m. of day 9 to 10 a.m. of day 11;
B. free nursing without DLS;
C. controlled nursing allowing 15 minutes nursing every day from kindling to the next AI; 48-hour DLS by closing the nestbox from 10 a.m. of day 9, after nursing, to 10 a.m. of day 11;
D. controlled nursing as above, without DLS.

In practice, in the C group a suckling was suppressed on the day before AI. All does were inseminated within 15 minutes after nursing their young, except the does of the B group subjected to free nursing without DLS.

Management.
The AI was performed with heterospermic pooled semen collected using IMV equipment, assessed for mass motility and extended (1:5) in a TRIS dilutor. The does were inseminated in the lordosis position with 0.6 ml of fresh diluted semen injected through a plastic single use pipette. Ovulation was induced at the moment of insemination by 20 μg of synthetic GnRH (Fertagyl, Intervet). Litter size was equalised to 8-9 young within the group, depending on the total available number of young rabbits. The litters were weaned 35 days after birth.

Measurements.
At AI, receptive does were identified by their turgid red or purple vulva colour. The fertility rate (number of kindlings/number of inseminations x 100), total number born and young born alive were recorded. Size and weight of litters were recorded after equalisation (day 1), immediately before DLS (day 9), and at weaning (day 35). Litters were also weighed at 71 days, during the fattening period.

Statistical analysis.
Only data of lactating does were considered. Does that were discovered as ill or with three consecutive unsuccessful inseminations were eliminated from the analysis. Data were statistically analysed using the GLM procedure of SAS 6.12 (1989). Receptivity and fertility were considered as Bernoulli variables (0-1). Analysis of variance includes the effect of the treatment (2 levels: 48-hour DLS, control), the nursing system (2 levels: free and controlled) and the parity (2 levels: 1 and ≥ 2), and all their interactions. The differences between means were tested by Student “t” test. Rabbit losses were analysed using a chi-square test. In the tables, the least square means with standard errors are presented. The significance is reported in the tables only for the main effects. The interactions were never significant.

RESULTS AND DISCUSSION

Reproductive performance of lactating does. The nursing system affected fertility (P≤0.05), which was higher in the controlled nursing does (Table 1), especially when they were not stimulated by the litter separation (+21.7%). The DLS treatment resulted in higher (P≤0.05) receptivity and fertility. When nursing was free, doe-litter separation (DLS) improved receptivity by +20.5% (P≤0.05), and fertility by +22.6% (P≤0.05). The improvement was less evident for the controlled nursing does, (+14.8% and +8.9%, respectively) and the differences were not significant. This latter result confirmed the observations of Szendro *et al.* (1999) and Bonanno *et al.* (1999) on separated controlled nursing does.

Table 1. Effect of nursing system and 48-hour doe-litter separation (DLS) on the reproductive performance of lactating does (LSM ± se).

Nursing system (NS)	Free nursing		Controlled nursing		Significance			RSD
Treatment (TR)	A DLS	B Control	C DLS	D Control	NS	TR	Parity	
Inseminations (n)	131	100	109	101				
Receptivity (%)	74.2 ±7.4 a	53.7 ±7.3 b	73.3 ±7.5 ab	58.5 ±7.5 ab		*		46.6
Fertility (%)	69.2 ±7.4 ABb	46.6 ±7.3 Aa	77.2 ±7.5 Bb	68.3 ±7.5 ABb	*	*		46.6
Total born (n)	8.62 ±0.62	8.45±0.76	8.15 ±0.57	9.01 ±0.68				3.1
Born alive (n)	7.9 ±0.7	7.6 ±0.8	7.7 ±0.6	7.1 ±0.7				3.6
Still-born (n)	0.56 ±0.24	0.63 ±0.30	0.39 ±0.22	0.48 ±0.27				1.2

A, B: P≤0.01; a, b: P≤0.05. * P≤0.05.

The reproductive performance was not influenced by parity and none of the interactions with parity was significant. The higher efficacy of DLS in improving fertility of does of first lactation orders, demonstrated in previous papers (Maertens *et al.*, 1998; Bonanno *et al.*, 1999; Szendro *et al.*,1999; Virag *et al.*, 1999), did not emerge here. The prolificacy and the viability of young at birth were not significantly affected by the factors considered.

Litter performance

. From equalisation until weaning, litter size, individual weight and daily gain were not influenced by the nursing system although on days 9 and 35, litter size was slightly higher in the controlled nursed groups (Table 2). In the period in which the controlled suckling was applied, from birth to day 9, and comparing DLS groups, lower rabbit losses occurred in the CN group (7.4 *vs* 11.4%, P≤0.01).

In agreement with the previous results, litter size at weaning was not affected by treatment, but it was slightly higher in the DLS groups, for both nursing systems. Rabbit losses from day 9 to 35 were lower (P≤0.05) in the DLS than the control.

Individual weaning weight and daily gain were not affected by nursing system or DLS. For both nursing systems, kits from the separated litters were only 21-22 g lighter than the control, which is equal to a weight reduction of only 2.5-2.6%.

Table 2. Effect of nursing system and 48-hour doe-litter separation (DLS) on the litter performance (LSM ±se).

Nursing system (NS)		Free nursing		Controlled nursing		Significance			RSD
Treatment (TR)	Age (d)	A DLS	B Control	C DLS	D Control	NS	TR	Parity	
Litter size (n)	**1** (1)	8.43 ±0.10	8.48 ±0.10	8.21 ±0.10	8.51 ±0.10			*	0.69
	9	7.35 ±0.19	7.69 ±0.20	7.71 ±0.20	7.86 ±0.19				1.4
	35	7.07 ±0.27	6.59 ±0.28	7.19 ±0.25	7.02 ±0.26				1.8
Rabbit losses (%)	**1-9**	11.4 Aa	9.2 ABab	7.4 Bb	8.7 ABb	**			14.3 (2)
	9-35	8.0 Aa	14.1 Bb	8.8 ACa	11.8 BCb		**	**	130.4 (2)
	35-71	9.4 ABb	12.3 Aa	8.9 ABb	7.1 Bb	**			11.3 (2)
Weight (g)	**1** (1)	64.4 ±1.5	64.8 ±1.5	67.4 ±1.5	62.6 ±1.5				10.4
	9	170.4 ±4.9	175.9 ±5.0	174.4 ±5.0	165.3 ±4.9			**	35.0
	35	816 ±16	838 ±16	803 ±15	824 ±15				99.7
	71	2042 ±12 Aa	2085 ±13 Bb	2049 ±12 ABb	2079 ±13 ABb		**		301.3
Daily gain (g)	**1-9**	13.66 ±0.44	13.50 ±0.46	13.10 ±0.46	12.72 ±0.45			**	3.1
	9-35	24.01 ±0.64	25.28 ±0.68	23.40 ±0.60	24.00 ±0.63				4.2
	35-71	33.91 ±0.33	34.32 ±0.37	34.04 ±0.35	34.70 ±0.37				8.7

A, B: P≤0.01; a, b: P≤0.05. * P≤0.05; ** P≤0.01

(1) After litter equalisation.

(2) χ^2.

DLS caused a reduction ($P \leq 0.01$) in weight of the free suckled kits on day 71. The differences in weight between the treated and untreated group were -43 g ($P \leq 0.01$) for the free and -30 g for the controlled suckling. These differences are not very important being only -2.1% and -1.4%, respectively, for free and controlled nursing. Daily gain from day 35 to day 71 was not significantly different between the groups. Fattening data confirmed that the rabbits did not exhibit compensatory growth, as observed in the experiments of Bonanno *et al.* (1999) and Szendro *et al.* (1999). The rabbit losses during fattening were the highest in the B group; this aspect could explain the significantly higher weight on day 71 of these rabbits than the A group, but it does not seem to be a consequence of the treatment.

Parity influenced litter size on day 1, because the litters of primiparous does were always equalised to 8 young. Litters from does in their first lactation also showed, compared to multiparous does, a lower individual weight on day 9 (164 *vs* 179 g, $P \leq 0.01$), lower daily gain until day 9 (12.6 *vs* 13.9 g, $P \leq 0.01$), and higher rabbit losses during 9-35 days (21.5 *vs* 5.5%, $P \leq 0.01$), due to their lower milk yield.

Also in these cases, the interactions with parity were always not significant. Nevertheless, it was noticed that the reduction of the weaning weight of the separated litters involved only the multiparous does (lactation order ≥2), and the difference was more pronounced between free nursing groups (-43 g, $P \leq 0.01$ at "t" test) rather than controlled nursing groups (-28 g). This trend was in conformity with previous results that showed that DLS reduced the weaning weight of litters of does with lactation order ≥5 (Bonanno *et al.,* 1999).

Doe replacement.

During the experiment, 55.3%, 57.9%, 69.2% and 66.7% of does were replaced in groups A, B (free nursing) and C, D (controlled nursing), respectively. Higher percentages were seen with controlled nursing, whereas DLS (groups A and C) did not seem to influence replacement. The does eliminated because of mastitis were 13.1%, 7.9%, 15.4% and 15.4% in the groups A, B, C and D respectively. These values were also higher with controlled nursing. The does of the group B showed the lowest incidence of mastitis probably because of their reduced fertility, and the consequent smaller number of lactations during their careers.

Productivity index.

The ratio between the rabbit meat production at 71 days and the number of AI on all lactating and non-lactating does during the experiment can be used as a global productivity index to compare the experimental groups. This index was 7.8, 6.1, 7.6 and 7.1 kg for groups A, B, C and D, respectively. It can be seen that DLS improved productivity by 28% when applied on free nursing does, and only by 7% on controlled nursing does. Controlled suckling resulted in a 16% improvement in comparison with free suckling when DLS was not applied, but the improvement was only by 3% between the DLS groups.

CONCLUSIONS

Without DLS, controlled nursing, compared with free nursing, improved fertility and global productivity. It also reduced the losses of young from birth to day 9. However, it seemed to increase the rate of doe replacement and mastitis.

The positive effect of a 48-hour DLS in improving receptivity, fertility and global productivity of lactating does was evident on free nursing does. With controlled nursing does, the lower effect observed was consistent with the hypothesis advanced..

It was also confirmed that a 48-hour DLS did not affect the survival of young rabbits before weaning; furthermore, in this experiment, DLS seemed to reduce the rabbit losses during the pre-weaning period for both suckling systems.

The reduction in weaning and fattening weight of litters separated from their dam was quite moderate in this study and was not influenced by the nursing system. The difference in weaning weight was evident only on the litters of multiparous does (lactation order ≥2), and within them it was higher with free nursing than with controlled nursing.

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