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EFFECT OF A LESS CONCENTRATED WEANING DIET AND AN EXTENSIVE REPRODUCTIVE MANAGEMENT ON THE LONG TERM RABBIT DOE PERFORMANCE AT PARTURITION

Martínez-Vallespín B., Martínez-Paredes E., Ródenas L., Cervera C., Pascual J.J., Blas E.*

Instituto de Ciencia y Tecnología Animal, Universidad Politécnica de Valencia, Camino de Vera 14, 46071 Valencia, Spain
*Corresponding author: eblas@dca.upv.es

ABSTRACT

The effects of using a less concentrated weaning diet and of delaying the insemination and the weaning on the performance of rabbit does at parturition were studied in successive cycles, from 2nd to 6thparturition. A total of 188 primiparous females were involved in the experiment; they were distributed in 4 groups in a factorial design, with 2 feeding systems (FS) and 2 reproductive managements (RM). Groups C28 and C42 were kept on a conventional FS, receiving a commercial reproduction diet (diet R) during the whole experiment; groups E28 and E42 were kept on an experimental FS, receiving a less concentrated weaning diet (diet E) from 18th day post-partum (dpp) until weaning. Groups C28 and E28 were managed in a semi-intensive RM: insemination at 11thdpp and weaning at 28thdpp; groups C42 and E42 were managed in an extensive RM: insemination at 25thdpp and weaning at 42nddpp.The number of kits born alive was lower in E42 than in C42 (–1.2±0.4, *P*=0.004), although the difference in litter weight did not reach the significance level (–32±18 g, *P*=0.088) because of compensatory effect of higher individual weight of kits in E42 than in C42 (+3.5±1.5 g, *P*=0.022). At 2nd-3rd parturitions, litter size was higher in the extensive than in the semi-intensive RM (+1.3±0.4, *P*<0.001), although the difference in litter weight did not reach the significance level (+32±17 g, *P*=0.063) because of lower individual weight of kits in the extensive than in the semi-intensive RM (–5.0±1.4 g, *P*<0.001). On the contrary, performance at 4th-6th parturitions decreased in the extensive RM, with lower litter size (–0.8±0.4 g, *P*=0.026), similar individual weight of kits (–1.0±1.3 g, *P*>0.1) and lower litter weight (–58±16 g, *P*<0.001) than in the semi-intensive RM.

Keywords: Rabbit does, parturition, weaning diet, reproductive management.

INTRODUCTION

The high incidence of digestive disorders, especially of Epizootic Rabbit Enteropathy(ERE) in commercial farms (Le Bouquin *et al*., 2009; Rosell *et al*., 2009) have led to propose new feeding strategies to promote digestive health of young rabbits, as mainly the development of specific diets for the period around weaning (Gidenne *et al*., 2010). As a practical approach, it has been suggested the possible supply of these weaning diets in combined feeding of females and young rabbits in late lactation. In that respect, Martínez-Vallespín *et al*. (2011) observed, in an ERE context, that less concentrated weaning diets reduced the mortality rate of growing rabbits but impaired milk yield and body condition of females at weaning, since high nutritive requirements of rabbits does selected for high performance requires the use of concentrated diets (Pascual *et al*., 2003).

On the other hand, a clear trend to change the usual reproductive management delaying both insemination and weaning has been observed in field conditions in the last years, because of an empiric decrease in mortality rate of young rabbits during the growth period, which could be explained by the protective role of rabbit milk (Gallois *et al*., 2007). However, longer lactations could compromise the productive career of rabbit does by exacerbating their negative energy balance (Xiccato *et al*., 2004).

No information is available about the long term effects of the use of less concentrated weaning diets and of the delay of insemination and weaning on the rabbit does. The aim of this work was to study the effects of both strategies on the performance of rabbit does at parturition in successive cycles.

MATERIALS AND METHODS

Experimental design

A total of 188 primiparous rabbit does (crossbred from the maternal lines A and V, Universidad Politécnica de Valencia) were controlled until 6th parturition. At 1st parturition, they were distributed in 4 groups in a factorial design, with 2 feeding systems (FS) and 2 reproductive managements (RM). Groups C28 and C42 were kept on a conventional FS, receiving a commercial reproduction diet (diet R) during the whole experiment; groups E28 and E42 were kept on an experimental FS, receiving a less concentrated weaning diet (diet E) from 18th day post-partum (dpp). Groups C28 and E28 were managed in a semi-intensive RM: insemination at 11thdpp and weaning at 28thdpp; groups C42 and E42 were managed in an extensive RM: insemination at 25thdpp and weaning at 42nddpp. The rabbit does were inseminated in weekly batches with pooled semen (growth line R, Universidad Politécnica de Valencia) at mentioned dates and each 21 days afterwards if needed. Figure 1 illustrates the scheme of the experimental design.

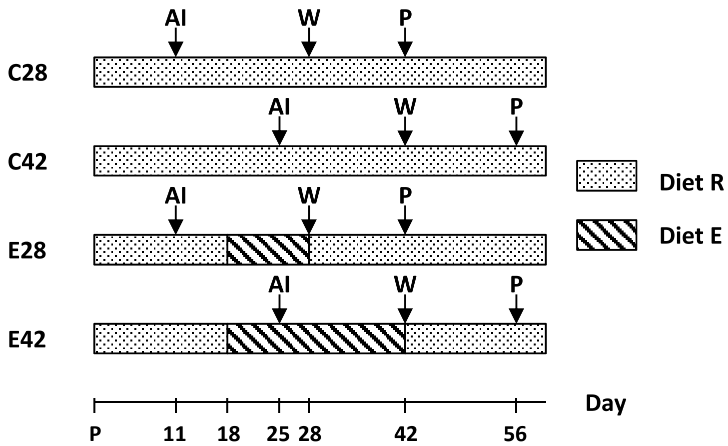

Figure 1. Scheme of the experimental design.P: parturition; AI: artificial insemination; W: weaning.

Diets

Table 1 shows the chemical composition of the diets. Compared with Diet R, Diet E was a less concentrated diet, rich in fibre fractions and low in starch. Chemical analyses were performed according to the methods of the AOAC (2000): 934.01 for dry matter, 942.05 for ash, 976.06 for crude protein and 920.39 for ether extract, with acid-hydrolysis of samples prior to the extraction. Starch content was determined according to Batey (1982), by a two-step enzymatic procedure with solubilisation and hydrolysis to maltodextrins with thermo-stable α-amylase followed by complete hydrolysis with amyloglucosidase, the resulting glucose being measured by the hexokinase/glucose-6 phosphate dehydrogenase/NADP system. Neutral detergent fibre, acid detergent fibre and acid detergent lignin fractions were analysed sequentially (Van Soest*et al.*, 1991) with a thermo-stable α-amylase pre-treatment and expressed exclusive of residual ash, using a nylon filter bag system. Neutral detergent soluble fibre content was determined according to Hall *et al.* (1997), adapting the method to the nylon filter bag system and with the following modifications: a Soxhlet extraction of the samples with petroleum ether (6 hours) was performed prior to the ethanol-water extraction and the neutral detergent extraction was carried out on the ether-ethanol insoluble residue instead of on the raw sample.

Table 1. Chemical composition of the diets (g/kg dry matter).

Diets[1]	Diet R	Diet E
Organic matter	912	924
Crude protein	170	162
Ether extract	36	78
Starch	135	31
Neutral detergent fibre	391	498
Acid detergent fibre	191	300
Acid detergent lignin	35	112
Neutral detergent soluble fibre	112	174
Digestible energy[2] (MJ/kg dry matter)	10.9	10.0

[1] Diet R: commercial reproduction diet (®Cunilactal); Diet E: weaning diet.
[2] Calculated according to Villamide *et al.*(2010) and Fundación Española para el Desarrollo de la Nutrición Animal (2010).

Animal housing and management

Animals were housed in an experimental farm equipped with forced ventilation and cooling system to maintain the temperature within the range of 12 to 25ºC throughout the experimental period (May to July of the following year). A photoperiod of 16 hours of light and 8 hours of darkness was established using artificial lights just in the months in which was needed. Breeding cages (50×70×32 cm) were provided with nesting boxes. Litter size and weight were registered at birth.

Statistical analysis

Data were analysed with the SAS software (Statistical Analysis Systems Institute, 2002). A MIXED procedure was used in a repeated measure design, the model including the FS, the RM, the parity order (PO, from 2 to 6) as repeated measure factor, the concurrence of pregnancy and lactation in the previous productive cycle, as well as the interactions between these factors, with a permanent effect of each rabbit doe (nested to FS×RM) and the error as random factors.To analyse fertility and stillborn rates, a GENMOD procedure was used according to the above described model.

RESULTS AND DISCUSSION

Results are summarised in Table 2. Fertility and stillborn rates averaged 74.8% and 4.14%, respectively, and were unaffected by the considered effects. In the case of semi-intensive RM, a less concentrated diet offered from 18thdpp (7 days after insemination) until weaning (at 28thdpp) did not affect litter size and weight at birth. On the contrary, the number of kits born alive was lower in E42 than in C42 (–1.2±0.4, P=0.004), although the difference in litter weight did not reach the significance level (–32±18 g, P=0.088) because of compensatory effect of higher individual weight of kits in E42 than in C42 (+3.5±1.5 g, P=0.022). Feugier and Fortun-Lamothe (2006) reported lower fetal mortality when inseminating at 25ththan at 11thdpp, although the effect was too small to significantly affect the litter size at birth. The current study revealed a dietary effect in the case of extensive RM, since litter size was negatively affected when a less concentrated diet was offered from 18thdpp (7 days before insemination) until weaning (at 42nddpp).

Significant interactions between RM and PO were detected (Figure 2). At 2nd-3rd parturitions, litter size was higher in the extensive than in the semi-intensive RM (+1.3±0.4, P<0.001), although the difference in litter weight did not reach the significance level (+32±17 g, P=0.063) because of lower individual weight of kits in the extensive than in the semi-intensive RM (–5.0±1.4 g, P<0.001). On the contrary, performance at 4th-6th parturitions decreased in the extensive RM, with lower litter size (–0.8±0.4 g, P=0.026), similar individual weight of kits (–1.0±1.3 g, P>0.1) and lower litter weight (–58±16 g, P<0.001) than in the semi-intensive RM. These results suggest a positive effect of delaying insemination from 11th to 25thdpp in lactating high performing rabbit does on prolificacy at 2nd and 3rd parturitions. Afterwards, at 4th to 6th

parturitions, lower litter size and weight at birth in the extensive RM could be illustrating an adaptation process to greater physiological effort linked to longer lactations (42 *vs.* 28 days).

Table 2. Effect of the feeding system (FS) and the reproductive management (RM) on rabbit doe performance at parturition (LSM±SE).

	Group[1]				Contrast[2] (estimate ± SE)		Interactions[3]
	C28	C42	E28	E42	FS	RM	
Number of observations[4]	196 (46)	198 (45)	194 (43)	174 (45)			
Fertility rate(%)	72.6	78.3	74.1	74.3	-0.6	3.0	
Stillborn rate (%)	4.38	4.07	3.78	4.34	-0.17	0.14	
Litter size, born alive	11.4 ± 0.3^{ab}	12.0 ± 0.3^{a}	11.3 ± 0.3^{ab}	10.8 ± 0.3^{b}	$-0.6\pm0.3^{*}$	0.1±0.3	$FS\times RM^{*}$ $RM\times PO^{***}$
Average weight of born alive (g)	62.1 ± 1.1^{a}	57.5 ± 1.1^{b}	61.7 ± 1.1^{a}	61.0 ± 0.3^{a}	1.5±1.1	$-2.6\pm1.1^{*}$	$FS\times RM^{\dagger}$ $RM\times PO^{*}$
Litter weight, born alive (g)	677 ± 13^{a}	669 ± 13^{ab}	672 ± 14^{ab}	637 ± 14^{b}	-19±13	-22±13	$RM\times PO^{***}$

[1] C28: conventional feeding system, insemination at 11th day post-partum (dpp) and weaning at 28thdpp; C42: conventional feeding system, insemination at 25thdpp and weaning at 42nddpp; E28: experimental feeding system, insemination at 11thdpp and weaning at 28thdpp; E42: experimental feeding system, insemination at 25thdpp and weaning at 42nddpp.

[2]FS=[(E28+E42)/2–(C28+C42)/2]; RM=[(C42+E42)/2–(C28+E28)/2].

[3] PO: parity order.

[4]Number of rabbit does between brackets.

† *P*<0.1; **P*<0.05; ***P*<0.01; ****P*<0.001

a, b, Within a row, means not sharing any common superscript are significantly different (*P*<0.05).

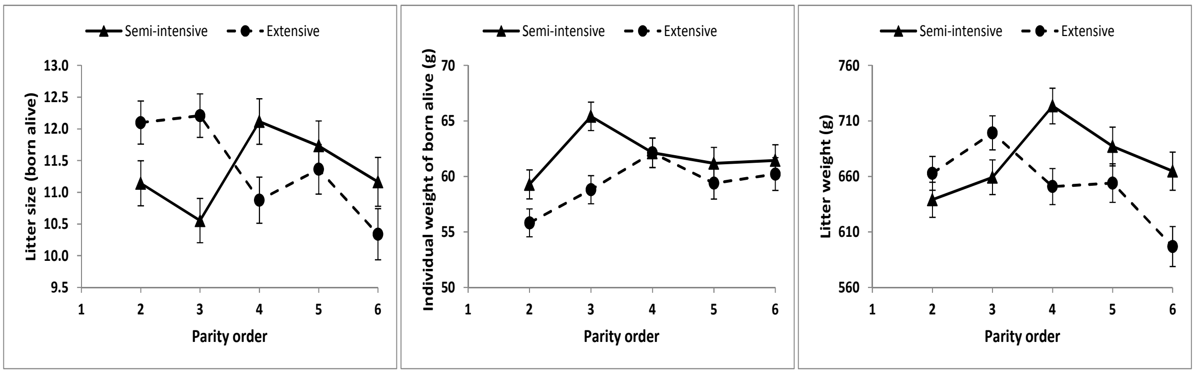

Figure 2. Rabbit doe performance from 2nd to 6th parturition according to reproductive management.Semi-intensive: insemination at 11th day post-partum (dpp) and weaning at 28thdpp; Extensive: insemination at 25thdpp and weaning at 42nddpp.

CONCLUSIONS

The use of a less concentrated diet from 18thdpp until weaning in high performing rabbit does might impair prolificacy, mainly under extensive RM (insemination at 25thdpp and weaning at 42nddpp). Compared to the semi-intensive RM (insemination at 11thdpp and weaning at 28thdpp), the extensive RM had a positive effect on prolificacy at 2nd and 3rd parturitions, but negative effect on both litter size and weight at 4th to 6th parturitions.

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