FEEDING PROGRAM FOR YOUNG RABBIT DOES ACCORDING TO THEIR GENETIC LEVEL

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ABSTRACT

A total of 167 crossbred young rabbit does were used to study the combined effects of: i. genetic level of the females (H1 vs. H2 females come from the cross of old and current generations of maternal lines selected for litter size);ii. the feeding program during the rearing period: *ad libitum* distribution of a high fibrous diet (F) or restricted distribution of a middle energy diet (M); iii. and, the pre-partum feeding program: high energy diet (E) or middle energy diet (M) on the development of young rabbit does until their first parturition and the main litter traits at first kindling. H2 does presented a significant larger number of total and alive pups at birth (+2.06 alive pups) than H1, greater than that expected (+1.06). The use of a high-fibre diet significantly decreased the weight gain of does during the rearing period (-294 g), but increased it during the first 4 weeks of gestation (+79 g) as consequence of a higher energy intake. The feeding program during the rearing period did not influence the fertility of does at first AI. Does receiving F diet until 28th day of gestation showed a significantly greater energy intake during the pre-partum and their number of pups born alive was significantly lower (-1.3 pups), showing that its combination with a high energy diet during the pre-partum period could affect the reproductive traits. In conclusion, it appears from the results of this trial that, when crossbred nulliparous rabbit does pertaining to old and current generations from two lines selected by litter size criteria are contemporarily compared, the selection response seems to be greater than that expected. In addition, *ad libitum* distribution of high-fibre diets from 3 months of age did not affect the fertility of does at first AI, but its combination with a high energy diet during the pre-partum period could decrease the number of born alive pups.

Key words: selection, feeding program, body condition, young rabbit does.

INTRODUCTION

Rabbit does have been successfully selected for prolificacy in recent decades (GARCÍA and BASELGA, 2002a,b; TUDELA *et al.*, 2003), and this improvement could have changed the nutritional requirements of these does. There is a lack of information in the literature about the possible effect of genetic selection for litter size on the development of young

rabbit does until their first parturition, as the adequate management of the animals related to their genetic level.
In addition, several works have tried to stimulate the voluntary food intake throughout the use of fibrous diets until first parturition in young rabbit does (NIZZA *et al.*, 1997; XICCATO *et al.*, 1999; PASCUAL *et al.*, 2002) showing in some cases improvement of the performance traits of does during their first lactation. However, the feeding program could also affect the development of young does (if it is adopted too early) and performance at first parturition (number of pups born alive, survival index...).
Therefore, the aim of the present work was to study the effect of: two types of crossbred does coming from the cross of different generations of maternal lines selected for litter size, the use of a feeding programme based on a high fibrous diet during rearing and the distribution of a high energy diet during pre-partum period on the development of young rabbit does until their first parturition and the main litter traits at first kindling.

MATERIAL AND METHODS

Animals

The lines involved were the maternal lines A and V selected within line for litter size at weaning and the paternal line R undergoing individual selection for post-weaning daily gain (UPV-Animal Breeding Unit). The 167 young crossbred does came from mating does of the line V to bucks of the A line. The young were the progeny of the crossbred does mated to bucks of the R line. H1 and H2 does came from the cross of females of generations 15 and 26 of the line V with bucks of generations 16 and 29 of line A, respectively. The young rabbits H1 and H2 were obtained mating does H1 and H2 to bucks of generation 6 and 18 of line R, respectively. Old generations were stored as frozen embryos and thawed and transferred to get live adults contemporary to the current generations.

Diets

The main ingredients and chemical composition of the experimental pelleted diets used in this trial are summarised in the Table 1. Starting from a medium concentrate diet (M) similar to a commercial diet for rabbit does, a high energy diet (E) was formulated adding cereal starch, vegetal oil and animal fat. A high fibre diet (F) was formulated almost exclusively with lucerne (96%). So, digestible energy (DE) and protein (DP) contents in diet F were lower than the standard value (9 MJ kg^{-1} DM) considered allowing a compensatory intake.

Apparent digestibility coefficients were determined for each diet using a total of 30 three-way crossbreed rabbits, as described by PÉREZ *et al.*, 1995. Chemical analysis of diets and faeces were performed following the methods of the AOAC (AOAC, 1991) for DM, ash, ether extract (EE), crude protein (CP) and crude fibre (CF), and VAN SOEST *et al.* (1991) for fibre fractions, with a thermostable amylase pre-treatment. Gross energy (GE) was determined by adiabatic bomb calorimetry (EGRAN, 2001).

Table 1: Chemical composition (% DM) of the experimental diets)

	Diets		
	M	**E**	**F**
Dry matter (%)	89.3	89.6	87.2
Ash	10.1	8.4	14.8
Ether extract	5.1	8.2	3.9
Crude fibre	13.1	12.3	20.3
Neutral detergent fibre	28.9	26.5	36.4
Acid detergent fibre	15.6	14.5	24.4
Acid detergent lignine	2.2	1.7	5.2
Crude protein	17.6	18.0	16.8
Digestible protein	12.6	13.3	11.3
Digestible energy (MJ/kg DM)	10.8	12.6	7.3

Experimental procedures

Combining the types of animals and feed, three groups were formed until 28th days of gestation (H1M, H2M and H2F) and five experimental groups (H1MM, H1ME, H2MM, H2ME and H2FE) from this moment to parturition. Until 3 months of age, all the animals received the same commercial diet, and subsequently, does were housed in individual cages and had free access to one of the experimental diets. The young does of the groups H1M and H2M received M diet and were restricted (140 g/ day) from 3 months of age to the 28th days of their first gestation, but young does of H2F were fed *ad libitum* with F diet during this same period. Does were artificially inseminated (AI) at 4.5 months of age with semen of R males. After this date, successive inseminations were carried out every 14 days, when necessary. After 28th day of gestation, gestating does were fed *ad libitum* with M diet in the groups H1MM and H2MM, and with E diet in the groups H1ME, H2ME and H2FE. The traits controlled for the does were: live weight and feed intake during rearing time, first 4 weeks of gestation and pre-partum period. The recorded traits for the litter were: total litter size and total and alive litter weight at birth.

Statistical analysis

The models used to analyse doe and litter traits were mixed models that included the experimental group as a fixed effect and for some traits the initial live weight of does at the beginning of the rearing period as a covariate. The random effects considered were the additive values of the does and the residual. Statistical analyses of data were carried out by generalised least squares under these models, using the PEST program (GROENEVELD, 1990). Values in the middle of the range of the h^2 found in the literature were used for solving the models. The statistical significance was computed at $\alpha = 0.05$.

RESULTS AND DISCUSSION

The type of doe did not affect the live weight increase and the feed intake of does (101 g DM per day) during the rearing period (Table 2). However, H2M does showed a greater live weight increase (+79 g) than H1M does during their first gestation.

On the other hand, the use of a high-fibre diet involved a significantly lower growth of does during the rearing period (-294 g), in spite of their greater feed intake (+40 g DM per day). Therefore, H2F group presented a significantly lower live weight at AI (-259 g) than H2M group, but as consequence of their higher feed and energy intake during the first 4 weeks of gestation (+51 kJ DE per day), H2F does showed a greater live weight increase during this period (+79 g) than H2M does.

Contrary to results observed by PASCUAL *et al.* (2002), where does receiving a all-lucerne diet had one week of retard at first AI, H2F does were fertilised at a similar date than H2M (please include some numerical and statistical results concerning this point). Therefore, when energy content of the rearing diet allows the compensatory energy intake (XICCATO *et al.,* 1999) or high fibre diets are given later than 3 months of age, young females don't seem to present a retard in their reproductive ability.

Table 2: Effect of type of does (H1M-H2M) and type of rearing feed (H2M-H2F) on main performance traits of does during rearing and gestation (0-28 days).

	n	H1M	H2M	H2F	SEM
LW at 3-months age (g)	167	2980	2917	2987	49
Rearing LW change (g)	151	+800^{b}	+786^{b}	+492^{a}	33
Feed intake: g DM/day	151	138.02^{a}	136.7^{a}	177.8^{b}	2.3
MJ DE/kgLW$^{0.75}$·day	151	605.4^{b}	601.3^{b}	542.8^{a}	7.9
LW at insemination (g)	157	3799^{b}	3741^{b}	3481^{a}	36
Gestation LW change (g)	156	+355^{a}	+434^{b}	+513^{c}	32
Feed intake: g DM/day	156	129.1^{a}	128.4^{a}	195.8^{b}	2.4
MJ DE/kgLW$^{0.75}$·day	156	495.2^{a}	496.0^{a}	535.2^{b}	7.7
Time to effective insemination (days)	166	38.8	36.6	38.3	2.2

LW: Live weight.
[a,b,c] Means within a row do not sharing any superscript are significantly different (P<0.05).
H1 and H2 refer to type of doe; the next letter to the rearing diet (M or F).
SEM: standard error of the mean

The Table 3 shows the results obtained during the pre-partum period and at kindling for each type of does, and each feeding program during rearing and pre-partum period. H2M does presented a significant larger number of total and alive pups at birth (+2.06 alive pups) than H1M. As consequence, H2M does (-493 g) showed greater live weight losses than those observed for H1M does (-378 g) at parturition and higher total litter weight at birth (+61.8 g). Considering the direct within line response per generation of A and V lines (0.082 and 0.095 born alive pups per litter, respectively) evaluated by GARCÍA and BASELGA (2002 a, b), the expected superiority of H2 does over H1 does, would be 1.06 pups, lower than the observed value (+2.06). Recently, COSTA *et al.* (2004) have also observed a greater response (+1.16 alive pups) than that expected (+0.49 alive pups) in crossbred does. These results are compatible with an increase of the differences between lines V and A along the selection and consequently with an increment of the heterosis.

The use of a high energy diet during the pre-partum period produced a significant decrease of feed intake (-19.1 g DM per day; P<0.05), leading to similar DE intake in each groups (1040 and 970 kJ DE per day for M and E diets, respectively). Type of pre-partum feed did not affect the number and weight of pups at birth, but does receiving E diet showed a greater live weight losses at parturition (-103 g).

Respect to the effect of the type of rearing diets, does receiving F diet until 28th day of gestation showed a greater feed and energy intake during the pre-partum period than H2ME does (862 and 1362 kJ ED per day for H2ME and H2FE does, respectively; P<0.05). The greater energy intake seems to be used for foetal and mother growth. Therefore, as consequence of the greater individual size of pups (+6.4±3.1g per pup at birth; P<0.05) and to the slightly large pre-partum period (+0.25 days; P<???), the pup mortality at birth was significantly greater in this group (1.9 and 8.7% for H2ME and H2FE does, respectively; P<0.05).

Table 3: Effect of type of does (H1-H2), type of rearing diet (M-F) and type of pre-partum diet (M-E) in the live weight anf feed intake of does during the pre-partum period (28 days of gestation to partum) and reproductive performance at first parturition.

	n	H1MM	H1ME	H2MM	H2ME	H2FE	SEM
Pre-partum:							
LW change (g)	158	-322^{a}	-435^{ab}	-447^{ab}	-540^{b}	-414^{b}	49
Feed intake: g DM/day	158	105.5^{c}	84.5^{b}	93.8^{bc}	65.7^{a}	108.5^{c}	9.9
MJ DE/kg·LW$^{0.75}$·day	158	419.6^{ab}	379.8^{a}	366.3^{a}	330.6^{a}	501.7^{b}	42.6
Partum:							
Total litter size at birth	162	8.84^{a}	8.88^{a}	11.08^{b}	10.43^{b}	9.75^{ab}	0.59
Alive litter size at birth	162	8.33^{a}	8.29^{a}	10.52^{b}	10.23^{b}	8.90^{a}	0.66

LW: Live weight.
^{a,b,c} Means within a row do not sharing any superscript are significantly different (P<0.05).
H1 and H2 refer to type of doe; the next letter to the rearing diet (M or F) and the last letter to the prepartum diet (M or E).

In conclusion, it appears from the results of this trial that comparisons of does from crossing of old or current generations of lines selected for litter size lead to response (litter size) greater than that expected. In addition, the use of high-fibre diets did not delay the reproductive development of does if they are given from 3 months of age, but its combination with a high energy diet at pre-partum could decrease the number of born alive pups.

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