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REARING-DIET STRATEGY AND PRODUCTIVE LONGEVITY OF CROSSBREED RABBIT DOES

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ABSTRACT

A total of 619 crossbreed rabbit does were controlled from 63 days old to the time of death, culling or censored record (7% of censored records with a minimum age of 647 d) to evaluate how rearing-diet strategy can affects the productive their life span. During the rearing period (from 63 days old to 1st parturition), the animals were divided in two groups, according to the diet received. A total of 308 females received a control diet (C; 18.4% crude protein and 19.5% acid detergent fibre) and 311 females received a fibrous diet (F; 13.4% crude protein and 23.4% acid detergent fibre). The diet received during this period affected rearing development, reproductive performance and lifespan of rabbit does. The use of the diet F seems to avoid the possible overconditioning of young females fed diet C at first insemination (−238 g of live weight and −0.35 mm of perirenal fat thickness; P<0.05), and it did not affect their long term reproductive performance (49.5 and 51.0 kits born alive per female for diets C and F, respectively). Young females reared with diet F lived on average 46.4 days longer than those receiving diet C (P<0.05), which also occurred at early reproductive life (+4.0 and +5.0 % at 2nd partum and weaning time, respectively). This longer life lead to a higher total production of kits per female reared (+7.4 kits born alive per female; P<0.05).

Key words: Rabbit, rearing-diet, crossbreed-does, longevity and reproduction.

INTRODUCTION

The use of high fibre diets during the rearing period of future breeding females is a well known strategy to avoid problems related with over conditioning during the early reproductive life (Martínez-Paredes *et al.*, 2012). Some relevant advantages of this strategy as the improvement in the voluntary feed intake, and better reproductive performance and/or body status at the end of first reproductive cycle have been described (Nizza *et al.*, 1997; Xiccato *et al.*,1999; Pascual *et al.*, 2002; Quevedo *et al.*, 2005). The direct effects of this feeding strategy on development and early reproductive life could also be reflected on female's lifespan. Theilgaard *et al.* (2006) identified the low genetic level, the high litter size (bigger than10 kits) and the deviation of adequate body condition as factors that could increase the relative risk of a doe to be culled or death. These authors also found that first lactation and the gestation as periods of higher risk. An extensive study on the culling and mortality in breeding rabbits support these results (Rosell and de la Fuente, 2009). On the other hand, the breeding programs have been successful in improve the litter size at weaning and the post-weaning daily gain in three-way cross schemes, and consequently female nutrient demand have increased (Quevedo *et al.*, 2006), that could affect their stay ability.

Under these conditions, rearing programmes allowing adequate body development and promoting the voluntary feed intake of young reproductive rabbit does could contribute to improve their lifespan. Therefore, the present work aims to describe the effects of using a fibrous diet during rearing period on longevity of crossbreed rabbit does.

MATERIALS AND METHODS

A total of 619 crossbreed young rabbit females (UPV lines A×V) were controlled from 63d old to failure or censoring time. During the rearing period (from 63 d old to 1st parturition), young does had *ad libitum* access to one of the two experimental diets: 308 females fed a control diet (C) and 311 females fed a fibrous diet (F). From 1st parturition, all females had free access to the diet C, being controlled until the failure or censoring time. The experiment was carried out from May 2009 to Oct 2011, where observations of live animals were considered as censored (7% of females with a minimum age of 647 d were considered as censored).

Table 1: Ingredients and chemical composition of experimental diets used during the rearing period (from 63d old to 1st parturition).

Ingredients (g /kg)	Control diet (C)	Fibrous diet (F)
Alfalfa meal	29.0	41.2
Wheat bran	30.0	18.1
Beet pulp	8.74	15.6
Cereal straw	-	15.1
Sunflower meal	16.0	5.00
Soybean meal	2.77	-
Barley	7.18	2.00
Soybean oil	1.69	1.00
Sugarcane molasses	2.00	-
L - Lysine HCl	0.15	-
Methionine – OH	0.10	-
L - Threonine	-	0.17
Calcium carbonate	1.27	-
Dicalcium phosphate	-	0.63
Sodium chloride	0.40	0.50
Vitamin and Mineral Premix	0.20	0.20
Cycostat 66G ®[1]	0.50	0.50
Chemical composition (g/kg of dry matter)		
Crude protein	18.4	13.4
Acid detergent fibre	19.5	23.4
Ether extract	5.00	2.60

[1]Alpharma, Antwerp (Belgium), provides 66 ppm of robenidine.

The experiment was held in a commercial farm with individual cages. A photoperiod of 16h light and 8h dark and artificial insemination (AI) at day 18th post-parturition was applied. Adoptions were also done; litters being equalized to a maximum of 9 kits for primiparous and 11 kits for multiparous does. The live weight (LW) was controlled at reception and every 21 or 28d until the 1st parturition (*i.e.* selection farm batches serially provided animals each 21-28 d; a total of 10 batches of 64 animals were used). The perirenal fat thickness (PFT) was measured at 1stAI (at 161d old) by means of ultrasound as described by Pascual *et al.* (2000). Litter sizes at birth and weaning were recorded for each reproductive cycle, and results are presented as the sum of the number of kits born, stillborn, weaned or lost (*i.e.* death in the lactation period) produced per female during their reproductive career. Also, the parturition interval was determined as the difference in days between two consecutive parturitions. Failure time was calculated as the difference between the day of death or culling and the day of reception on farm. Culling reasons was infertility (3 consecutive negative inseminations before start the reproductive life); low productivity (less than 7 kits weaned in 3 consecutive cycles) or health disorders (sore hocks, mastitis, abortions and low body condition). Data from rabbit does alive at the end of experimental period were treated as censored records.

A variance analyse, where the model included the diet as fixed effect and reception time as covariate, was performed to analyse the effect of rearing diet on reproductive performance traits and PFT [proc GLM of SAS (2009)]. A repeated mixed model with a spatial power covariance structure was used to describe the LW evolution during rearing period for each diet. Also, a logistic growth function[1] was fitted [proc NLIN of SAS (2009)] to the LW data and a sum of square reduction test, comparing the full and reduced model for different parameter estimation, was performed. Time series data were analysed using a proportional hazard regression [proc PHREG of SAS (2009)]. A stratified Cox proportional hazard regression was used to describe the hazard risk under the following equation:

$$h_{ijk} = h_{i0} . e^{X'_{ijk}.\beta} + \varepsilon_{ijk};$$

where h_{i0} represents the base risk of batch *i* (from 1 to 10), X'_{ijk} represents the design matrix of *k* rabbit doe, on *j* diet and batch *i* ,and β represents the vector of regression coefficients. Also, a Bayesian inference was performed, considering a flat prior, a Markov chain of 10.000 samples long, with a burn-in of 2.000 samples, and thinned by 1.

RESULTS AND DISCUSSION

Table 2 represents the estimation parameters for the logistic growth function of the young rabbit females from 63 d of age to first parturition, while Figure 1 represents the real and fitted LW evolution of young rabbit females during rearing period.

Table 2: Logistic growth curve parameters estimation, their respective standard error estimation (SE) and 95% confidence interval (CI)

Parameter[1]	C diet		F diet	
	Estimation ± SE	95% CI	Estimation ± SE	95% CI
a	4471.6± 42.6	[4388; 4555]	4424.7± 48.4	[4330; 4520]
b	8.69± 0.38	[7.94; 9.45]	6.67±0.23	[6.22;7.11]
k	0.0268± 0.001	[0.0254; 0.0282]	0.0226±0.001	[0.0215;0.0238]

[1]The parameters a, b and k represent the estimation of adult weight, integration coefficient and the slope of the curve, respectively; b also represents the inflexion point.

Difference between diets (C *vs.* F) for the estimated parameters (*a*, *b* and *k*) presented the following approximated 95% confidence intervals: [–175.4; 81.57], [–2.88; –1.18] and [–0.006; –0.0002], respectively. From these values, it can be deduced that there are not differences in the estimation of adult live weight (*a*) or growth rate (*k*) parameters for both dietary treatments. In fact, fitted curves are almost parallel from 88 (*i.e.* where curves get split) to 188 d, while real ones lost the parallelism at last period (from 163 to 188 d). However, type of diet given during the rearing period significantly changed the estimated parameter *b*, which is related to the point of inflection of the curve (delaying in growth). In addition, the PFT at 1st AI was significantly (P<0.05) lower for young females reared with the F diet (6.21 ±0.09) respect to those fed with the C diet (6.56±0.1). Thus, the use of the diet F seems to avoid a possible over conditioning of young females fed diet C at first insemination (–238 g of LW and –0.35 mm of PFT; P<0.05). Martínez-Paredes *et al.* (2012) also described how the use of a low energy diet could lead females to achieve the critical LW and fat mass at first AI to ensure reproduction. In the present experiment, the use of a fibrous diet during the rearing period succeeded in reduces the cumulative LW and PFT depot at AI of rabbit does without impairing reproductive performance. In fact, fertility rate at first AI was similar between groups (82.7 and 80.3% for diets C and F, respectively), as well as the other reproductive parameters measured.

In addition, the rearing diet affected the lifespan of rabbit females (Figure 2). Females given the diet F during rearing lived significantly longer (324.2 ±13.2 d) than those fed with the diet C (277.8 ±14.3 d). The relative risk of culling was 13.4% lower for does from diet F respect to does from diet C. The Bayesian inference described a 95.5% of chance that the hazard ratio of diet C is greater than that of diet F. As hypothesized, the direct effects of a fibrous diet on the development of young does improved their lifespan, mainly due to the higher early survival registered for the F group (+4.4 and +5.1% at 1st and 4th parturitions). Similar results have been previously reported in young rabbits

Logistic growth function : : $LW = a \times \{1 + [b \times \exp(-k \times time)]\}^{-1}$

(Martínez-Paredes *et al.*, 2012) and gilts (Hoge and Bates, 2011), where slower early growing was related to lower risk of culling.

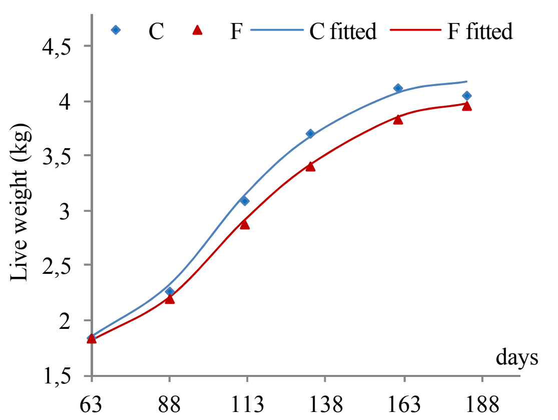

Figure1: Actual female live weight evolution during rearing period and fitted logistic growth curve by diet received during rearing

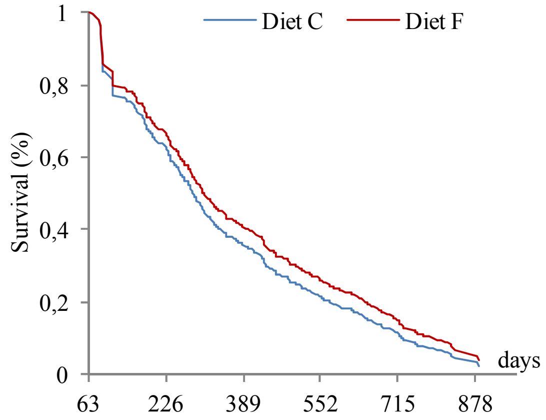

Figure 2: Survival probability across time (from day 63 to censor time) from does fed with diet C or F during rearing period.

On the other hand, the effect of rearing diet on total reproductive performance registered during the experiment respect to whole population or females with a success reproduction (*i.e.:* minimum one parturition with one or more kits born alive) is summarized in the Table 3. This definition of success reproduction group occurred at the same time-point of the survival analysis (around 2nd AI, when females were 200d old). The use of a high fibre diet during rearing period increased the number of females that succeed on reproduction by reducing the mortality during rearing period (91 *vs.* 58 deaths on C and F diet, respectively) and during the 1st reproductive cycle (123 *vs.* 83 deaths on C and F diet, respectively).

Table 3: Effect of rearing diet on total number of kits born alive (TNBA), stillborn (TNSB), weaned and death during lactation per female during their reproductive career controlled (mean ± SEM). Results are referred to does that reached at least one parturition with one or more kits born alive (success reproduction) and the whole population, including all the females housed at 63d.

Population	Diet	N	N kits born alive	N stillborn kits	N weaned kits	N kits dead lactation
Success reproduction	C	185	49.5±2.5	6.2±0.5	42.0±2.2	7.9±0.5
	F	228	51.0±2.3	4.9±0.5	43.0±2.0	7.2±0.4
Whole population	C	308	30.5±2.1	3.8±0.4	23.7±1.7	4.4±0.3
	F	311	37.9±2.1	3.6±0.4	29.6±1.7	4.9±0.3

Females reared with a high fibre diet did not negatively affect their long term reproductive performance, as population of rabbit does that succeed on reproduction had similar average values for total productivity (TNBA+TNSB) in both groups (55.7±2.8 and 55.9±2.5 for diet C and F, respectively). In fact, does reared on diet F even presented a lower total number of kits stillborn respect to those given the diet C (–1.3 kits; P<0.05). These results agreed to those previously described by Martínez-Paredes *et al.* (2012), where the litters of females reared with different programmes using fibrous diets presented lower mortality at birth than those fed with a control diet *ad libitum* (on average 10 and 21%, respectively).

When whole population was considered, higher survival of females reared with the diet F lead to a higher production of kits per female reared (+7.4 kits born alive more than those reared on diet C; P>0.05). The benefits of fibre diets on body development (*i.e.* high feed capacity, adequate LW and fat content at insemination and/or a lower body energy mobilisation during lactation) and reproduction (*e.g.* lower mortality at birth) were, also previously reported (Rebollar *et al.*, 2011; Martínez-Paredes *et al.*, 2012).

CONCLUSION

The use of a high fibre diet during the rearing period seems to allow a smooth pre-puberty growth of young rabbit females, resulting in an adequate body conditioning at the beginning of their reproductive career. Main consequences of this better conditioning seem to be an increased lifespan at early reproductive life and lower number of kits stillborn, which lead to higher total productivity (kits born alive and weaned) per female reared.

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