

THE EFFECT OF SELECTION FOR GROWTH RATE ON THE LIVE WEIGHT GROWTH CURVE IN RABBITS

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Abstract - Gompertz growth curves were fitted to 125 rabbits, divided in two groups, control (C) and selected (S). Animals come from a synthetic rabbit line selected on growth rate. Embryos from generations 3rd and 4th were frozen and thawed to be contemporary of rabbits of generation 10th. Group C was constituted by offspring of generations 3rd and 4th, and group S by contemporary offspring of generation 10th. Animals were individually weighed twice a week the first four weeks, and once a week until 20 weeks of age. Then males were weekly weighed until 40 weeks of age. At commercial slaughter age (10 weeks) selected animals have increased near a 10% their live weight, showing a genetic progress of 1.5% over the mean per generation. No sexual dimorphism was observed at 10 weeks of age, but this dimorphism appeared at 17 and 19 weeks of age in group C and S respectively, being the females heavier than the males. As a consequence of selection, live weight of selected animals increased along all the growth curve. Adult weight, estimated as the A parameter of the Gompertz curve, was a 10% higher in the selected line.

INTRODUCTION

Current commercial programs of rabbit selection normally include a terminal sire selected on growth rate. Selection on growth rate can modify the whole growth curve of rabbits, changing the age at which commercial slaughter weight is raised. However, due to the short generation interval in rabbits, this selection could lead soon to undesirable consequences. TAYLOR (1985) has noted that selection for growth rate could considerably increase adult weight. This may produce large animals difficult to handle, with higher maintenance costs and some proclivity to legs disease. Live weight growth curves are needed to determine an economically acceptable age of slaughter, and to examine the consequences of selection on growth rate for further strategies and selection objectives, related, for example, to the increment of adult weight and the possible change of the slope of the curve.

Growth curves have been fitted in rabbit by BARON, VEZINHET and CANTIER (1970), FL'AK (1982), RUDOLPH and SOTTO (1984), BLASCO *et al.* (1990) and BLASCO et GOMEZ (1993), but only BLASCO *et al.* (1990) examined the consequences of selection for growth rate in growth curves. However, this last study was made without any control population. Although not strictly necessary, it is very convenient to have a control population to examine the effects of selection, otherwise it has to be supposed that the environment is the same when measuring the animals before and after selection. Even when a control population is available, the comparison remains difficult due to genetic drift. The aim of this research is to examine the effect of selection for growth rate on rabbit growth curves. In this study embryos were frozen and thawed after performing several generations of selection, in order to have a control population in which genetic drift is minimised.

MATERIAL AND METHODS

Animals come from a synthetic rabbit line selected on growth rate. This line was originated by mating a synthetic line with a Californian line which was previously selected on growth rate for 12 generations. The former synthetic line was created by mating commercial crossbred rabbits and it was selected for growth rate for 3 generations.

Embryos from generations 3rd and 4th were frozen and thawed to be contemporary of rabbits of generation 10th. The procedure has been described by VICENTE and GARCIA (1993a, 1993b). The offspring of these thawed embryos constituted the control group (C). They were contemporaries of the offspring of the 10th generation of selection (selected group, S). Four males and two females from generation 3rd and one male and three females from generation 4th produced the line C, whereas 6 males and 15 females generated the line S. In both cases mating between relatives was avoided.

All the rabbits from groups C and S were born between October 1994 and June 1995. Animals were individually weighed twice a week the first four weeks, and once a week until 20 weeks of age. Then males were weekly weighed until 40 weeks of age.

Weaning took place at 4 weeks of age. After weaning, they were placed in flat-deck cages, 8 rabbits per cage, until they were 9 weeks old, and they were fed ad libitum with a commercial diet (16.0% crude protein, 15.5% fibre, 3.4% fat). Then they were placed in individual cages and the same food was restricted to approx. 140 g per day. At 20 weeks of age they were placed in individual flat-deck reproductive cages, and a commercial diet with 17.5% crude protein, 14.5% of fibre and 3.4% of fat was provided. The number of animals weighed at 10, 20, 30 and 40 weeks of age is shown in table 1. Data of animals with signs of illness were excluded from the analysis.

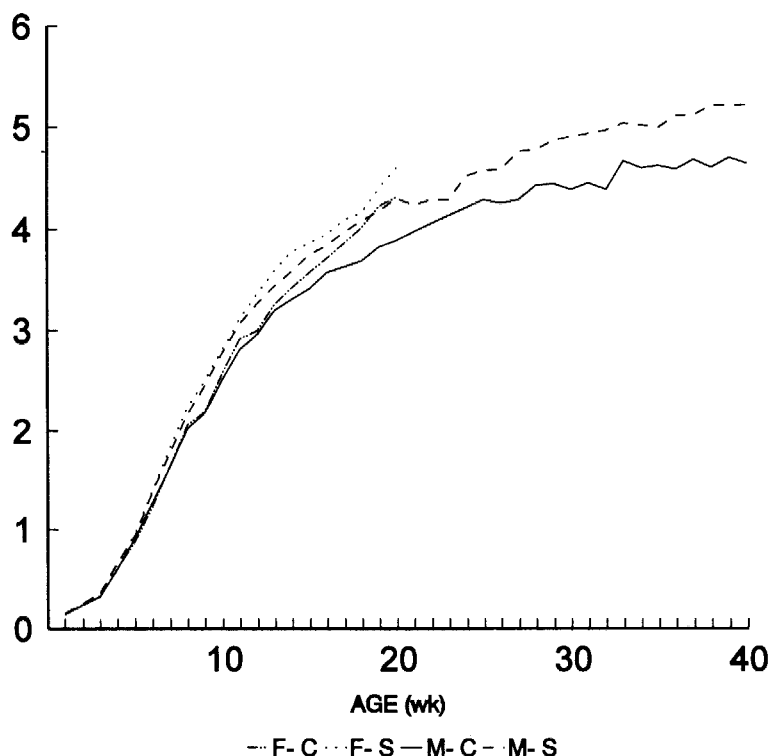
Least square means of live weight were estimated at 10, 20, 30 and 40 weeks of age in both C and S groups. GOMPertz growth curves were fitted by using the non-linear regression procedure of the SAS statistical package.

RESULTS AND DISCUSSION

Table 1 shows the least square means of live weights at various ages. Data of females more of 20 weeks old have not been included, since they were later pregnant and this would modify the growth curve. At commercial slaughter age (10 weeks) selected animals increased near a 10% their live weight, showing a genetic progress of 1.5% over the mean per generation. The consequence of this progress is a reduction of the age of slaughter, because the slaughter weight is fixed by the market. This has some desirable consequences, like a probable reduction of the food conversion rate, as TORRES *et al* (1992) have suggested, but the animals will be more immature when slaughtered. Thus the carcasses are expected to have a poorer carcass yield and a lower meat/bone ratio, as PLA *et al* (1996) have showed by comparing two breeds of different adult size at the same commercial weight.

Figure 1 shows the weekly averages of live weight. A clear break appears between weeks 3 and 4, when young rabbits start eating food and weaning takes place, and a linear period of growth can be observed from this break until the 15th-16th weeks of age. Adult weight does not seem to be reached at 40 weeks of age, although the weekly increment of live weight seems to be low after 30 weeks of age.

Figure 1. Weekly averages of live weight of males (M) and females (F) of control (C) and selected (S) groups



Adult weight, estimated as the A parameter of the GOMPERTZ growth curve, varies depending on data of how many weeks are used to estimate the curve. This result agrees with GOMEZ and BLASCO (1993) who observed an increment in the A parameter when it was estimated by using data from 20, 30 40 or 50 weeks of age, although the differences that they observed were lower than the differences we have found. This implies that adult weight is not still reached at 40 weeks of age, and that it is underestimated by the A parameter. The difficulties of the estimation of adult weight have been stressed by TAYLOR (1985), who recommends to refer it to a given proportion of body fat, since the fat tissue is very variable in the adult stage. Rabbits start their reproductive career when they are 20 weeks old and they are maintained for an average of 40 weeks in the farm. The differences in adult weight estimated with data up to 30 or 40 weeks of age are between a 4% and 5% of the adult weight. This means that the approximation given by using data up to 30 or 40 weeks of age would be accurate enough for most of the purposes for which adult weight is needed.

Results of table 1 should be taken as preliminary results of the experiment, since the standard errors are underestimated. It has not been taken into account the correlation between errors produced by the parental relationships between the animals. Moreover, the size of the errors augment with the age and a correction for this scale effect is needed. Autocorrelation between data of the same animal can also modify the structure of errors, although the use of data of several animals per week reduces this problem. Nevertheless the estimates of the curve parameters are unbiased and the fitting seems to be good.

Table 1. Least square means (LSM) of live weight at several ages, and GOMPERTZ growth curve parameters calculated with animals that arrived at 20, 30 or 40 weeks of age, of Control (C) and selected (S) group.

Age	Group	N	LSM (s.e.)	A (s.e.)	b (s.e.)	k (s.e.)	R ²
10 weeks	C-F	29	2579 (56) a				
	C-M	21	2518 (66) a				
	S-F	48	2813(44) b				
	S-M	27	2783 (58) b				
20 weeks	C-F	24	4320 (80) a	4473 (55)	4.49 (0.13)	0.029 (0.0007)	0.99
	C-M	18	3887 (93) b	3979 (32)	4.75 (0.12)	0.033 (0.0006)	0.99
	S-F	28	4616 (76) cb	4593 (37)	4.80 (0.11)	0.032 (0.0006)	0.99
	S-M	20	4306 (88) d	4364 (43)	4.76 (0.15)	0.033 (0.0008)	0.99
30 weeks	C-M	14	4391 (117) a	4309 (23)	4.21 (0.09)	0.028 (0.0004)	0.99
	S-M	18	4903 (104) b	4680 (28)	4.21 (0.11)	0.028 (0.0006)	0.99
40 weeks	C-M	10	4642 (157) a	4491 (21)	3.91(0.09)	0.026 (0.0004)	0.99
	S-M	15	5217 (128) b	4956 (24)	3.78 (0.10)	0.025 (0.0005)	0.99

F: females. M: males. N: Number of animals.

No sexual dimorphism is observed at 10 weeks of age, but this dimorphism appears at later ages. We found significant differences between sexes at 17 and 19 weeks of age in group C and S respectively, being the female heavier than the male. This seems to disagree with the previous results of GOMEZ and BLASCO (1992) and BLASCO and GOMEZ (1993), who did not find sexual dimorphism in rabbits of the same line. The reason could be the small sample size that they used for calculating growth curves.

Due to the short generation interval in rabbits, selection on growth rate can produce new giant breeds. Although genes of these breeds have often be included in the current terminal sire synthetic lines, many of the breeds

have almost disappeared. Several reasons contributed to the unpopularity of the giant breeds: they are difficult to handle, standard cages often produce leg diseases, they usually have a lower litter size and a poor carcass yield and they have higher costs of maintenance. None of these reasons seem to stop the use of highly efficient breeds as terminal sires in modern cuniculture. The actual development of artificial insemination dramatically reduces the amount of terminal sires needed in a farm, thus they would be specially cared if it is needed. A more serious problem is the probable poorer carcass yield and ratio meat/bone, which will be matter of further research.

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