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GROWTH AND SOME CARCASS TRAITS OF ADULT RABBITS UNDER HIGH AMBIENT TEMPERATURE

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SUMMARY : Forty-two medium sized crossbred rabbits, born and kept at a constant temperature (30°C), were divided into two groups. The first group remained under the same conditions, while the second group was allocated at weaning to a conventional building with an average minimum temperature of 20°C. The rabbits were weighed at 70, 100, 150, 200, 250 and 280 days, at which point they were slaughtered. The growth of the animals reared under the higher temperature was lower throughout the observation period. Their carcasses were lighter and thinner than the carcasses of the control group. The differences between other carcass traits were due to differences in liveweight or carcass weight.

RÉSUMÉ : Croissance et caractéristiques de carcasse de lapins adultes soumis à une température ambiante élevée.
Quarante deux lapins hybrides, nés et maintenus à une température constante de 30°C ont été répartis en deux groupes. Le premier fut maintenu dans les mêmes conditions tandis que le second fut placé au moment du sevrage dans un bâtiment conventionnel dont la température moyenne était de 20°C au minimum. Les lapins ont été pesés à 70, 100, 150, 200, 250 et 280 jours puis abattus. Pendant toute la période expérimentale, les lapins élevés à la température ambiante la plus haute ont eu une croissance plus faible. Les carcasses étaient plus légères et plus minces que celles du groupe de contrôle. Les différences concernant les autres caractéristiques de carcasses étaient dues au différences de poids vifs ou de poids des carcasses.

INTRODUCTION

The growth rate is impaired in rabbits kept under high ambient temperatures (SIMPLICIO *et al.*, 1988; STEPHAN, 1980). This is due to a reduced intake of feed. Conversely, a reduction in the feed intake, higher than 20 % of *ad libitum* ingestion, reduces dressing percentage in rabbits slaughtered at 3.2 kg (SCHLOLAUT *et al.*, 1978) and at 2 kg (LEBAS and LAPLACE, 1978) ; this reduction is related to a lower carcass fat content.

Moreover these studies have been performed for shorter periods than 26 weeks (POUJARDIEU and MATHERON, 1984). At this age, adult size has not been established : BLASCO and GOMEZ (1993) considered 210 days as a suitable period for establishing liveweight growth curves. We have tried to evaluate the growth of rabbits reared under a high temperature, from birth to 280 days of age.

Besides, the influence of the high temperature on carcass traits has not been studied with adults, in the present paper we report results of some carcass measurements taken from adult rabbits either reared in normal conditions or under high temperature.

MATERIALS AND METHODS

Forty-two medium sized three-way crossbred rabbits, born and kept in a climatic chamber at a constant temperature of 30°C, were weaned at 35 days of age. Half remained and the other half were allocated to a conventional building where the average minimum temperatures varied from 15°C inh April to 25°C in August. The average maximum varied from 21°C in April and November to 29°C in August. The respective averages, for minimum and maximum, were 20°C and 24°C.

After weaning the rabbits were transferred to cages containing eight animals, where they remained for ten weeks. They were then transferred to individual cages until reaching 40 weeks. The mortality after weaning was 19 %.

Table 1 : Liveweight of rabbits (kg) according to environment (climatic chamber at constant 30 °C or conventional building) and sex.

		Environment					Sex				
		30°C		Building			Males		Females		
Age days	Cov. WW. sig.	LSM	SE	LSM	SE	Sig	LSM	SE	LSM	SE	Sig
70	***	1.79	0.047	2.12	0.049	***	1.90	0.059	2.01	0.038	NS
100	***	2.39	0.051	2.93	0.054	***	2.59	0.065	2.73	0.042	NS
150	*	3.03	0.091	3.84	0.086	***	3.31	0.108	3.56	0.073	NS
200	NS	3.39	0.102	4.36	0.101	***	3.63	0.119	4.12	0.084	**
250	NS	3.67	0.124	4.82	0.119	***	3.93	0.146	4.55	0.099	**
280	NS	3.84	0.134	5.07	0.143	***	4.15	0.166	4.77	0.114	**

*** : P<0.001 ; ** : P<0.01 ; * : P<0.05 ; NS : non significant. ; COV = Covariate ; WW = Weaning Weight ; LSM = Least Square Mean ; SE = Standard Error

Rabbits were fed ad libitum on a commercial pelleted diet composed as following (g/kg) : 165 crude protein, 155 crude fibre, 34 ether extract. The animals had free access to water throughout the experiment.

All animals were weighed at 35, 70, 100, 150, 200, 250 and 280 days then thirty-four animals were slaughtered : 17 from the climatic chamber (6 males and 11 females) and 17 from the building (4 males and 13 females).

Without fasting, the animals were slaughtered and bled, and the skin was separated as for commercial use, but including the distal part of fore legs. The full gastrointestinal tract was removed, and the carcasses were refrigerated for 24 hours at 3°C. Carcasses were then weighed and measured according to the norms of the WRSA (BLASCO *et al.*, 1993) : length of the carcass (as the sum of dorsal length and thigh length), lumbar circumference, scapular fat and perirenal fat. The hypodermic abdominal fat was also measured.

All the data obtained were analyzed by variance-covariance analysis, using the SAS package (SAS, 1990), according to the following pattern:

$$Y_{ijk} = \mu + A_i + S_j + (AS)_{ij} + bx_{ijk} + e_{ijk}$$

where :

Y_{ijk} = dependent variable
μ = overall mean
A_i = fixed effect of environment (i = 1,2)
S_j = fixed effect of sex (j = 1,2)
$(AS)_{ij}$ = interaction sex - environment
x_{ijk} = covariate
b = regression coefficient
e_{ijk} = residual random effect

The weaning weight was used as a covariate in growth analyses ; liveweight and carcass weight were used as covariates in dressing and carcass traits analyses.

RESULTS AND DISCUSSION

Temperature had a significant effect on liveweight gain, and the results did not change when the weaning weight was introduced as a covariate (Table 1). The high temperature impaired growth for the period studied, up to maturity. Before maturity, this is a well-known effect in rabbit (STEPHAN, 1980 ; SIMPLICIO *et al.*, 1988 ; CHIERICATO *et al.*, 1993 ; CENTRODUCATI *et al.*, 1993) and other species and, in fact, we have observed in our conditions that does reared at 30°C seldom reached 3.5-4 kg at 4.5 months of age, a liveweight usually considered adequate for the first mating. Our results confirm that the negative effect of temperature on growth is not compensated at least until maturity is reached.

A difference in weight was observed in both sexes from 200 days onwards, females being heavier than males. The number of controlled males does not allow a general assessment to be made, but this sexual dimorphism has been reported in several papers (BLASCO and GOMEZ, 1993). Moreover, interaction environment-sex was not significant at any age.

Skin weight, gastrointestinal tract weight, and carcass weight were lower in animals from the climatic chamber (Table 2), as expected, considering their lower liveweight. When the analyses included slaughter weight as a covariate, these differences were

Table 2 : Slaughter parameters according to environment (climatic chamber at constant 30°C or conventional building) and sex.

			Environment					Sex				
			30°C		Building			Males		Females		
	Cov. WW sig.	R^2	LSM	SE	LSM	SE	Sig.	LSM	SE	LSM	SE	Sig
LW, g		0.649	3832	128	4989	135	***	4119	163	4701	105	**
SW, g		0.517	618	25	817	26	***	733	32	702	20	NS
	***	0.777	710	24	752	21	NS	792	24	677	15	***
FGTW, g		0.370	502	25	604	27	**	500	32	606	21	**
	NS	0.376	516	36	595	32	NS	508	36	603	22	*
CW, g		0.553	2483	111	3375	117	***	2800	142	3058	92	NS
	***	0.863	2989	88	3042	78	NS	3098	88	2933	54	NS
CDP %		0.124	64.57	1.2	67.60	1.27	NS	67.26	1.53	64.91	0.98	NS

*** : P<0.001, ** : P<0.01, * : P<0.05, NS : non significant ; LSM = Least Square Mean. SE = Standard Error. ; COV = Covariate. ; R^2 = Coefficient of multiple determination ; LW = Liveweight. ; SW: Skin Weight ; FGTW: Full Gastrointestinal Tract Weight ; CW: Commercial Carcass Weight ; CDP: Commercial Dressing Percentage

non significant. Dressing percentage was lesser (P = 0.08) for the animals from the climatic chamber (3 %) ; this difference is relevant.

Some differences related to sex were also observed. The females, heavier than males, had a lighter (but non significant) skin than males, and when liveweight is introduced as a covariate, the difference is highly significant. The gastrointestinal tract weight followed the opposite trend : higher for females and being both significant if corrected or not by liveweight, possibly because the urogenital tract is more developed in females.

Interaction between sex and environment was not significant in any dressing trait or carcass trait.

The length of the carcass was similar in both environments (Table 3), the animals at 30°C were lighter, no shorter but thinner, with less lumbar circumference (P = 0.08 in the analyse with covariate) and consequently had a lower weight/length ratio. These results are similar to those of CENTODUCATI *et al.* (1993), who reported a similar length, but a lesser lumbar carcass width, lesser intertrocanter length and lesser thoracic circumference in rabbits from 90 days reared at 15°C–20°C, by comparison with those rabbits reared at a lower temperature. The length/circumference ratio, whose differences are nearer to the statistical significance (P<0.08), was much lower (1.55 *vs* 1.96) than the reported values in animals with a commercial weight of 2 kg (BLASCO *et al.*, 1984).

The weight of dissectible fat was higher for animals in the building, but the differences were not significant when the covariate was applied, and they can be explained by the different carcass weight.

CHIERICATO *et al.* (1992) found higher values for fat deposits in rabbits reared at a low temperature (12°C) with respect to high temperature (30°C). Similarly, CHIERICATO *et al.* (1993) found higher values in winter than in summer, but CENTODUCATI *et al.* (1990) did not detect differences in fattening at different temperatures. Their values are from commercial rabbits, which are substantially different from the adult values.

NOUGUÉS and VEZINHET (1976) considered that the weight of adipose tissue is already stabilized at 300 days. They reported 89 and 20 g respectively for the perirenal and scapular deposits of Newzealand males, nearly half our values. Our values from perirenal fat are similar to the values measured by VEZINHET and PRUD'HON (1975), in the Montpellier breed, (139 g in males and 125 g in females).

Table 3 : Carcass parameters according to environment (climatic chamber at constant 30 °C or conventional building) and sex.

		Environment						Sex				
			30°C		Building			Males		Females		
	Cov. CW Sig.	R^2	LSM	SE	LSM	SE	Sig.	LSM	SE	LSM	SE	Sig.
L, mm		0.356.	341	4.1	348	4.3	NS	332	5.3	356	3.4	***
	**	0.488	349	4.8	341	4.6	NS	335	4.9	355	3.1	**
LCL, mm		0.578	204	3.6	235	3.8	***	216	4.6	222	2.9	NS
	***	0.857	217	2.7	224	2.6	NS	221	2.8	220	1.8	NS
L/LCL		0.427	1.68	0.03	1.49	0.03	***	1.55	0.03	1.61	0.02	NS
	*	0.519	1.63	0.03	1.53	0.03	NS	1.53	0.04	1.62	0.02	*
CW/L, g/mm		0.545	7.30	0.28	9.65	0.30	***	8.37	0.36	8.58	0.23	NS
S Fat, g		0.327	27	5.3	53	5.6	**	36	6.8	44	4.3	NS
	***	0.769	46	4.0	38	3.9	NS	43	4.1	41	2.6	NS
H A Fat, g		0.323	20	7.0	56	7.5	***	36	8.9	40	5.9	NS
	***	0.763	45	5.4	35	5.3	NS	44	5.5	35	3.6	NS
P Fat, g		0.462	96	16	200	15	***	133	20	162	13	NS
	***	0.763	148	13	159	13	NS	152	14	154	9	NS

*** : P<0.001, ** : P<0.01, * : P<0.05, NS : non significant ; LSM = Least Square Mean. SE = Standard Error. ; COV = Covariate. R^2 = Coefficient of multiple determination. ; CW = Commercial Carcass Weight. ; L : Total Length = Dorsal Length+Thigh Length. ; LCL : Lumbar Circumference. ; S Fat : Scapular fat. ; H A Fat : Hypodermic Abdominal Fat. ; P Fat : Perirenal Fat.

Females, longer than males, and with a similar circumference, had no different carcass weight. The ratio weight/length was similar for both sexes, although length/circumference was higher for the females. Both males and females had a similar degree of fatness. As previously commented, no definite conclusions can be drawn due to the low number of males used.

CONCLUSIONS

From weaning until 40 weeks, the liveweight of the rabbits reared at high temperature (30°C) was lower than of those reared in a conventional building. From 200 days onwards, females were heavier than males. The rabbits at 30°C, were not shorter but thinner, with a lower weight/length ratio. The dissectible fat deposits were lighter in rabbits from 30°C, but these differences can be explained by carcass weight.

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