GROWTH PERFORMANCE AND BEHAVIOR OF GROWING RABBITS SUBJECTED TO FEED RESTRICTION

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ABSTRACT

The aim of this work was to study the behavior and productive performance of fattening rabbits, subjected to feed restriction during the first 4 weeks of growing period. A total of 180 hybrid rabbits (NZ x C) of both sexes 35 days old, were divided into four groups of 45 animals each, logged in 9 cages (5 rabbits/cage). The four treatments were the control diet *ad libitum* (C) and three different levels of restriction according to the time of feed access: 5h/d (D5); 10h/d (D10) and access every other day, or skip a day (D24). In the last week, animals had permanent access to feed. The access to feed begins at 9:30 pm. Individual weight and feed intake per cage were controlled weekly. At the end of the first, third and fourth weeks, in order to evaluate the behavior of animals, they were filmed during one minute at different periods of the day (9:30, 12:00 and 19:30h). Data was analyzed and determined the percentage occurrence of each behavior. The access restriction to feed for D5 and D24 resulted, respectively, in decreases of 8% and 11% in the final live weight, 16% and 20% in weight gain and 19% and 27% in feed intake, but the feed efficiency increased 6% and 16%, compared to the control group. For the group D10, only significant differences were found in feed efficiency, which has an overall improvement of 16% compared with the control group. No significant effect was observed in health status of animals. In the behavioral ethogram, these restrictions caused a decrease in the occurrence of normal and an increase of abnormal behaviors. Access to feed 10 h per day seemed to be beneficial to rabbits because it does not impair growth and improve feed efficiency, but some behaviors were affected.

Key words: Rabbit, feed restriction, growth, behavior

INTRODUCTION

Feeding is the main cost in rabbit production, so the control of feed intake could be used to adjust the diet and nutritional requirements to manage the growth performances (Yakabu *et al.,* 2007; Bergaoui *et al.,* 2008).

Dietary restriction in post-weaning has been reported by several authors (Tumova *et al.,* 2002; Gidenne *et al.,* 2003; Yakabu *et al.,* 2007; Bovera *et al.,* 2008) as a preventive method of digestive disorders which are common in fattening rabbits at this age. The restriction of feed intake during the initial phase of growing period can reduce the rabbit growth, but later, if rabbits are fed *ad libitum,* they can present compensatory growth (Yakabu *et al.,* 2007; Bovera *et al.,* 2008). The application of feed restriction during fattening period of rabbits, without compromising too much the growth, may be a good strategy for rabbit management, because it may decrease the feeding cost and reduce the health risk (Gidenne *et al.,* 2003; Foubert *et al.,* 2008). However, studies from literature do not agree about the duration and level of restriction (Jerome *et al.,* 1998; Perrier *et al.,* 1998; Yakabu *et al.,* 2007; Gidenne *et al.,* 2009). Moreover, they did not consider the welfare of animals, which can be influenced by this management (Smulders *et al.,* 2006).

Thus, the aim of this work has been to study the growth performance and behavior of rabbits in the fattening period subject to different feed restriction methods.

MATERIALS AND METHODS

Animals and experimental design

This study was conducted at the University of Trás-os-Montes e Alto Douro (Portugal) and conducted in accordance with the requirements of animal welfare (Ports. 1005/92, 214/08, 635/09).

One hundred and eighty hybrids rabbits (C x Nz) of both sexes were used from weaning at 35 days of age until slaughter at 70 days. The rabbits were randomly divided in 4 groups of 45 animals each (4 treatments) and housed in 9 cages (5 animals per cage). The animals were kept in a house with controlled environment and received 12 hours of light per day (7:00h to 19:00h). They received a commercial diet in a feeding schedule according to Table 1. The four treatments were: control (C) with continuous access to feed, feeding 5 (D5) with access to the same feed 5 h per day; feeding 10 (D10) with access to feed 10 h per day, and feeding 24 (D24) with access to feed for 24 h in alternate days (skip a day diet system). The treatments were applied in the first four weeks of the trial and at week 5 the feed were supplied *ad libitum*. Water was always *ad libitum*.

Table 1: Availability of feed according to the treatments

Treatment	Day 1				Day 2				
	0:00h	9:30h	14:30h	19:30h	0:00h	9:30h	14:30h	19:30h	0:00h
C									
D5									
D10									
D24									

Measurements

Animals and feeders were weighed weekly to determine the live weight (LW) and the daily feed intake (FI) and to calculate the average daily gain (DG). Feed efficiency (FE), was calculated by the ratio between weight gain and feed intake. Live weight was controlled individually and the feed intake was calculated per cage. Mortality was monitored daily.

The study of behavior was done following an ethogram prepared in accordance with Gunn and Morton, (1995) and Lidfors (1997). The behaviors were obtained after video analysis to check if animals had some abilities of adaptation to the treatment. The videos were taken in the first, third and fourth week of the study. Each cage was filmed for one minute and repeated three times a day (9:30, 12:30 and 19:30 h). The cages were considered the units of observation, the number of occurrences of social, normal and abnormal types of behavior being registered. Briefly the main behaviors of each type were: social – allogrooming, being chased, circle, nuzzle, sniff pair-mates, scream; normal - resting with eyes closed, being alert with eyes open, sniffing cage, sniffing bars, sniffing itself, coprophagy, moving one or several body parts, hopping, running, eating pellets, drinking water, shaking and scratching itself and abnormal - licking itself, sham chewing (chewing without having any object or pellets in the mouth), bar-biting, licking parts of the cage, biting parts of the cage, digging against the cage, biting itself, biting water nipple, licking bars, sliding nose along bars, pressing head against nipple, trough, bars or wall, swinging head back and forth, running around several times in the same pattern. For each cage, the proportion of occurrences in relation to the number of rabbits present in the cage was calculated.

Statistical analysis

Statistical analysis was made using analysis of variance (GLM) and the treatment was the factor variation. The multiple comparisons of means were performed by Tukey test. Data analysis was performed using the JMP 5.01 program.

RESULTS AND DISCUSSION

The results of the performance of growth and mortality are presented in Table 2. At the end of both week 4 and the essay, the live weight of C and D10 rabbits (2438 g as average at slaughter) were similar, but significantly higher (P <0.0001) than those of D5 and D24 groups (2171 g as average). The final live weights achieved by the control and D10 rabbits, were similar to those obtained by Pinheiro et al. (2009) in a study performed under similar conditions. The decrease of live weight between the groups C and D5 was around 260g. These effects were less marked than those found by Yakabu *et al.* (2007) that worked in similar conditions.

Table 2: Productive performance of rabbits subjected to feed restriction.

		Treatment				MSE	Prob.
		C	D5	D10	D24		
Live Weight (g)	Weaning	988	1018	1012	1032	8.06	0.265
	Week 4	2171 ^{a}	1867 ^{b}	2156 ^{a}	1827 ^{b}	18.70	<0.001
	Slaughter	2392 ^{a}	2133 ^{b}	2483 ^{a}	2209 ^{b}	22.51	<0.001
Average daily gain (g/d)	Week 1 to 4	43.5 ^{a}	31.5 ^{b}	42.0 ^{a}	29.5 ^{b}	0.65	<0.001
	Week 5	31.6 ^{b}	38.8 ^{b}	42.1 ^{b}	55.3 ^{a}	2.23	0.002
	Total	41.3 ^{a}	32.9 ^{b}	43.1 ^{a}	34.6 ^{b}	0.63	<0.001
Feed Intake (g/d)	Week 1 to 4	128.3 ^{a}	85.6 ^{b}	119.9 ^{a}	92.3 ^{b}	3.75	<0.001
	Week 5	139.2 ^{b}	163.0 ^{a}	159.1 ^{ab}	180.1 ^{a}	4.37	0.006
	Total	135.8 ^{a}	98.6 ^{c}	129.1 ^{a}	110.2 ^{b}	2.76	<0.001
Feed efficiency	Week 1 to 4	0.34 ^{c}	0.40 ^{a}	0.37 ^{b}	0.34 ^{c}	0.006	<0.001
	Week 5	0.21 ^{b}	0.24 ^{ab}	0.30 ^{a}	0.30 ^{a}	0.014	0.024
	Total	0.31 ^{c}	0.37 ^{a}	0.36 ^{a}	0.33 ^{b}	0.005	<0.001
Mortality (%)	Week 1 to 4	0.07	0.00	0.00	0.00	0.038	-
	Week 5	0.00	0.02	0.11	0.09	0.026	-
	Total	0.07	0.02	0.11	0.09	0.049	0.515

Means with different letters on the same row differ significantly (Tukey test)

Treatments also affected weight gain (P <0.05) in the periods considered. In the three periods, there were no significant differences between the groups C and D10. In the period of restriction, weight gains of rabbits D5 and D24 (30.5 g/d) were 30% lower than those of group C. These results showed that the access to feed 5h/d and skip a day had similar negative effects on the growth of rabbits. The negative effects were also observed in total test period, although slightly attenuated by *ad libitum* feeding during the last week. Yakabu *et al.* (2007) found a lower reduction in weight gain (26%) of rabbits with skip a day diet system and Jerome *et al.* (1998) observed a decrease of 11.6% with access to feed 12 h/d.

During the period of feed restriction, feed intake was higher (P <0.001) in groups C and D10 than in D5 and D24 ones, that did not differ. The access to feed 10h/d resulted in a level of intake of 93% of *ad libitum,* lower feed restrictions than the observed with the access to feed 5h/d and the skip a day diet system (69.5%). However, during the total test period the D24 rabbits ingested 81% of *ad libitum* because of their higher intake during the final week of the experiment. Similar level of intake was observed by Jerome *et al.* (1998) and Yakabu *et al*. (2007) (80% and 73%, respectively).

In the first 4 weeks of the trial, the group D5 presented the best feed efficiency (0.40), followed by the D10 (0.37) and C and D24 (0.34) groups. However, during the *ad libitum* feeding period (week 5), groups D10 and D24 had the best feed efficiency (42% improvement compared to control). In the entire study, it was found that all the treatments with feed restriction have improved feed efficiency, as observed in several studies with different methods of dietary restriction (Jerome *et al.,* 1998; Bergaoui *et al.,* 2008; Bovera *et al.,* 2008). The best total feed efficiency was observed with D5 and D10 treatments.

Globally, the results showed that weight gain, live weight and feed intake of rabbits were influenced by the period of access to feed. Rabbits with 10 h/d had similar intake and growth performances to the ones with permanent access to feed, which indicates an adaptation of their feeding behaviour.

However if they have access to feed during a shorter period, like 5h/d, they reduce the feed intake and, consequently, worsen growth performances. However, rabbits were not able to adapt so well to the skip a day diet system (D24), since they have a daily average access to feed of 12 h, higher than D10 treatment, and they showed lower feed intake and growth.

The average mortality during the experiment was 7.2% as average, without significant differences between treatments, although it varied from 2% in the D5 and 11% in D10 groups. The small number of animals used in this work does not allow statistical analysis of this parameter.

The behavioral results are shown in Table 3. In the first week of the study, the occurrence of normal behavior was significantly higher in the group fed *ad libitum* (0.70), compared to groups D10 (0.46) and D5 (0.33). The group D24 (0.56) showed a smaller decrease of normal occurrences when compared with the control group, (around 20%) and this effect was not statistically significant.

Table 3: Behavior of rabbits subject to feed restrictions (expressed as proportion).

	Treatment				MSE	Prob.
	C	D5	D10	D24		
Week 1						
Normal	0.70 ^{a}	0.33 ^{c}	0.46 ^{bc}	0.56 ^{ab}	0.031	< 0.001
Social	0.28	0.16	0.29	0.22	0.022	0.105
Abnormal	0.02 ^{b}	0.50 ^{a}	0.26 ^{a}	0.21 ^{a}	0.039	< 0.001
Weeks 3 and 4						
Normal	0.76 ^{a}	0.40 ^{c}	0.54 ^{b}	0.50 ^{bc}	0.022	< 0.001
Social	0.22 ^{ab}	0.19 ^{b}	0.19 ^{b}	0.33 ^{a}	0.015	0.002
Abnormal	0.01 ^{c}	0.42 ^{a}	0.26 ^{b}	0.17 ^{b}	0.021	< 0.001

Means with different letters on the same row differ significantly (Tukey test)

In the first week, the abnormal behaviors had a lower incidence in group C (0.02) than in rabbits subjected to the feed restriction (0.32 as averaged) which showed the highest proportion of abnormal behaviors. The normal behavior is higher in C group and lower in D5 group, about half incidence, showing D10 and D24 group intermediate values. In the weeks 3 and 4, similar behavior patterns to those of the first week were observed, except for the social behaviors that differed significantly. Animals of D5 and D10 treatments showed lower social behavior than D24 group.

CONCLUSIONS

Severe feed restriction (5 h per day or skip a day) had a negative effect on growth of rabbits and on its behavior. Access to feed 10h per day seemed to be effective, because it did not affect growth and improved feed efficiency of rabbits, although the percentage of behavior considered normal decreased.

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