

GROWTH PERFORMANCES AND BEHAVIOR OF GROWING RABBITS HOUSED ON CAGES, CLOSED PARKS OR OPEN-AIR SYSTEM

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ABSTRACT

The study was carried to investigate the effect of housing systems on growth and behavior of growing rabbits. Were used 120 rabbits hybrid NZxC from weaning at 35 days of age to slaughter at 84 days. Rabbits were randomly assigned to three types of housings: cages (Cg), 10 collective cages of wire for 4 animals with 0.03 m² (0.5x0.6 m); closed parks (Cp), 10 pens with the area of 0.525 m² (1.05x0.5 m) with straw litter in the floor and (4 animals per pen); open-air system (Op), 2 outdoor pens with 80 m² (10x8 m) (20 animals per pen). The feed intake and live weight were controlled weekly. At 84 days of age, in each treatment 10 rabbits were randomly chosen and subject to an open-field test and 10 rabbits per treatment were slaughtered and the samples of blood were collected for measurement of hematocrit and corticosterone levels. The open-air system rabbits had a significantly lower final live weight (less 424 g or 14 %) than the Cg ones. Op rabbits showed lower weight gain (33.1 g/d vs. 41.8 g/d) and pellet feed intake (111.5 vs. 139.6 g/d) during the fattening period than Cg rabbits. Closed parks allowed similar growth and feed intake to the cages and better values than open-air system. The corticosterone and hematocrit levels were higher in rabbits housed in cages, which may indicate a worse welfare. Despite the difficulty of interpretation of locomotor activity in open-field tests, the results found in this work showed that animals reared in the open-air system walked a greater distance (P <0.05), than animals of other types of housing. The housing type of rabbit during the fattening period affects the growth performances, being worse in open-air system, and the behavior, being worse in cage system.

Key words: Rabbits, growth, behavior, cages, parks, open air

INTRODUCTION

In recent years consumers show a increasing preference for rabbit specialty products reared in alternative conditions systems to those of intensive ones, in which animals are generally housed in cages. It is expected higher meat quality and higher standards of animal welfare when animals are reared in alternative systems. Recently, several studies have examined alternative housing systems for fattening rabbits (Maertens and van Oeckel 2001, Orova *et al.*, 2004; Jekkel *et al.* 2010). Some studies reported that housing systems can affect body weight, growth, mortality and behavior (Chu *et al.* 2004; Sored *et al.*, 2004). Housing systems with floor pens or open air pens seem to reduce stress and aggressive behavior in animals (Maertens and van Oeckel 2000, Lebas 2001) but these systems increase mortality and decrease growth rates, feed intake and feed efficiency.

The pen housing systems provide more space and a more ‘natural’ environment than conventional cages, having the rabbits greater locomotor activity and therefore more energy needs (Dal Bosco *et al.*, 2000), in addition could decrease their weight gain (5–10%) and worsen feed conversion (Maertens and van Oeckel 2001).

In larger groups, the occurrence of aggressive behavior increases, which is disadvantageous for production and animal welfare (Bigler and Oester, 1996; Princz *et al.*, 2008). When the rabbits were reared in ground (especially in deep litter) the possibility of infection and enteritis increases and as a consequence higher mortality was recorded (Dal Bosco *et al.*, 2000).

The studies on extensive housing systems have often been inconclusive due to the numerous variables involved (stocking density, group size, type of pen, and others). The aim of the present study was to examine the effects of housing systems (cages, closed parks or open-air pens) on the growth performances and behavior of rabbits during a fattening period between 35 and 84 days.

MATERIALS AND METHODS

Animals and experimental design

The study was carried out at the Experimental Rabbit Facilities of the Animal Production Department at the University of Trás-os-Montes e Alto Douro (UTAD) in Portugal.

Hybrid rabbits (NZ×C) of both sexes were divided into three groups and subjected to two housing treatments: cage treatment (Cg), where rabbits were housed in cages; closed parks (Cp) where rabbits were housed in parks with litter in the floor and open-air treatment (Op) where rabbits were housed in a pasture pen. All rabbits fed *ad libitum* a commercial pellet feed and had free access to water. The in the open-air treatment animals also had access to the natural pasture available in the pen.

At 35 d the rabbits were sexed and tattooed for individual identification. Equal proportions of both sexes (50% males and 50% females) were housed in the cages, closed parks or open-air (figure 1)



Figure 1 – Housing systems of rabbits: cages (a), closed parks (b) and open-air parks (c)

Rabbits were controlled from 35 to 84 days of age (d). In the first group (Cg), 40 rabbits were lodged in 10 wire cages with 0.03 m² (0.5×0.6 m; 4 animals per cage). In the second group (Cp), 40 rabbits were lodged in 10 pens with litter in the floor with 0,525 m² (1.0.5×0.5 m; 4 animals per pen). These animals (cages and pens) were lodged in a temperature controlled building and were exposed to 12 h of light daily (8:00 to 20:00 h). The third group (Op) of 40 rabbits was kept in two open-air pens with 80 m² with natural pasture (10×8 m; 20 animals per pen) and in a natural environment. The study was conducted in May and June with an average temperature of 18 ° C (minimum 10 and maximum 26) and total precipitation of 50 mm.

Measurements

The individual body weights and feed intake of the rabbits were recorded weekly between 35 and 84d to determine the live weight, daily weight gain, daily feed intake and feed conversion rate. The pasture feed intake was not controlled. The deaths of rabbits were controlled daily to determine the mortality.

At 83 d, 10 rabbits were randomly chosen from each housing system and subject to open-field tests. The tests were performed in a closed room and behavior of rabbits was filmed during 10 minutes. The arena for the test was divided with white lines into 9 squares with 1 meter away. To start the test each rabbit was placed in the center of the arena. At the end of each test the arena floor was washed and disinfected to hide the smell of other rabbits. The films were digitally analyzed and obtained the locomotor activity behavior, time of locomotor activity (TLA) and the walked distance by the animal in locomotor activity (DAL). At end of trial others ten rabbits per treatment were slaughtered and samples of blood were collected for measurement of hematocrit and corticosterone levels. The serum corticosterone RIA kits (PITKRC-3) was used to determined the hormone levels at rabbits.

Statistical Analysis

The data were analyzed using analysis of variance (ANOVA) procedures and Tukey HSD test considering the type of housing as a factor of variation. All analyses were performed using JMP-SAS program. In the statistical analysis of growth data were considered three periods, between weaning (35 d) and 70 d (the usual age of slaughter of rabbits reared in intensive system), between 70 and 84 d (end of the essay) and the total period (form 35 to 84 d).

RESULTS AND DISCUSSION

The results of the growth trial are summarized in Table 1. The sex of the rabbits did not influence the growth performance, confirming the results of Oliveira and Lui (2006). In the present study, the mortality was not analyzed due the low number of dead rabbits (1 Cg rabbit and 2 Op rabbits).

In the global period (35 to 84 d), the rabbits reared in open air system had a final live weight significantly lower ($P < 0.05$; less 424 g or 14 %) than the caged rabbits. The final live weight was similar in cages or closed parks. In this period, the weight gain was also significantly higher in rabbits reared in cages or closed parks than in open air system, which is in accordance with the results observed by Lambertini *et al.* (2001), McNitt *et al.* (2003) and Pinheiro *et al.* (2011). The weight gain and feed intake of the caged rabbits were about 20 % higher than the observed in Op rabbits. The growth and feed intake were similar between cage and closed parks and better than open air.

The rabbits reared in open air system show the lowest growth performances. Probably, the intake of pasture by this group did not fully compensate the reduction of pellet feed intake and the intake of nutrients and the weight gain were reduced (McNitt *et al.* 2003). The reduction in feed intake in the outdoor rearing systems has been reported to play a role in the decline weight gains (Maertens and van Oeckel, 2000; Pinheiro *et al.*, 2011). However, other factors associated with open-air system also contribute to the negative effects observed on performances, namely the increase of the energy maintenance requirements of rabbits due to the increase of locomotor activity (Maertens and van Oeckel 2000) and energy expenditure with thermoregulation. The increase of available space had also a negative effect on growth performance (Princz *et al.*, 2008; Jekkel *et al.*, 2010).

Table 1: Live weight, weight gain and pellet feed intake of rabbits according housing type

	Treatment			MSE	Prob.
	Cage	Closed park	Open air		
Live weight (g)					
35 d	938.4	956.7	961.0	12.07	0.377
70 d	2512.3 ^a	2394 ^b	2098.2 ^c	28.33	<0.001
84 d	2987.3 ^a	2976.6 ^a	2563.3 ^b	36.37	<0.001
Weight gain (g/d)					
35-70 d	44.96 ^a	41.03 ^b	32.76 ^c	0.78	<0.001
70-84 d	33.93 ^{ab}	40.21 ^a	31.66 ^b	1.89	0.011
35-84 d	41.81 ^a	41.36 ^a	33.13 ^b	0.76	<0.001
Pellet feed Intake (g/d)					
35-70 d	131.35 ^a	122.02 ^a	97.32 ^b	2.77	<0.001
70-84 d	159.42 ^b	179.81 ^a	138.04 ^a	4.22	0.003
35-84 d	139.62 ^a	133.33 ^{ab}	111.46 ^b	2.83	0.02

Means with different letters on the same row differ significantly (Tukey test). In average daily gain n=40 per treatment; in feed intake and feed conversion ratio n=10 in cages and closed park and n=2 in open air

In first phase of growing period (35 to 70 d), the results were similar to those reported for the total period. In the second phase (70 to 84 d) the performances of rabbits reared in parks were similar to the observed in the first phase but the performances of Cg rabbits were depressed (Table 1). This change in growth and feed intake could indicate that the animals in cages have some problems, which contributes to the decreased of growth performance. Usually, rabbits housed in cages are slaughtered at 70 days of age and when they are raised after this age the lack of space due to its high body weight compromise the its growth .

The results of the behavior indicators are presented in Table 2. The time spent in locomotor activity and the hematocrit value were not affected by treatment. When the walked distance by the animal in locomotors

activity in open field test was analyzed, the animals of closed parks exhibit the highest value, superior to those observed with rabbits reared in cages or open air. Rabbits reared in cages or open air walked similar distances. The Cp animals, walk almost twice the distance that covered by the animals of the other groups in a similar time, which may indicate a better adaptation to rearing conditions. The corticosterone concentration in the blood was higher in Cg rabbits than in those logged in the open park. The concentration of this hormone in closed park rabbits was between the concentrations observed in the other two groups and the differences were not significant. The lowest corticosterone concentration of rabbits housed in open air system may indicate a lower stress and better welfare during growing period. In a previously work Jekker *et al.* (2010) observed that housing rabbits in pens with deep litter, has a favorable effect on both social and stereotype behaviors frequency.

Table 2: Behavior indicators according housing type

	Treatment			MSE	Prob
	Cage	Closed park	Open-air		
TLA	7.88	7.45	8.21	0.717	0.752
DAL	23.22 ^b	40.67 ^a	22.44 ^b	4.716	0.018
Corticosterone (ug/ml)	11.40 ^A	9.61 ^{AB}	5.15 ^B	1.34	0.009
Hematocrit (%)	44.2	41.25	40.6	1.19	0.082

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

Time of locomotor activity (TLA) and the walked distance by the animal in locomotors activity (DAL)

CONCLUSIONS

The rearing of rabbits in the open parks worse the growth performance in relation to rabbits that are raised in cages and in closed parks, however increase the animal welfare. It will be interesting repeat this work with a larger sample in order to study the effects of housing system on mortality and carcass quality.

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