

GROWTH AND CARCASS CHARACTERISTICS OF RABBITS HOUSED IN OPEN-AIR OR STANDARD SYSTEMS

Pinheiro V.^{1,2*}, Silva S.R.^{1,2}, Silva J.A.², Outor-Monteiro D.², Mourão J.L.^{1,2}

¹CECAV, UTAD, PO Box 1013, 5001-801 Vila Real, Portugal

²Department of Animal Science, UTAD, PO Box 1013, 5001-801 Vila Real, Portugal

*Corresponding author: vpinheir@utad.pt

ABSTRACT

A study was carried out to investigate the effects of two housing systems on the performance, carcass traits and meat quality of growing rabbits. Ninety-six rabbits were used from 59 to 87 days of age. Forty eight rabbits were housed in 12 wired cages (0.5×0.6 m; 4 rabbits/cage) and 48 rabbits were housed in one open-air pasture pen (20×9 m). The growth performances were measured during the growing period. At 87 d, 12 rabbits per treatment were slaughtered and carcass characteristics determined according to the WRSA norms. Rabbits reared in cages showed higher ($P<0.05$) weight gain (45.9 vs. 34.2 g/d), pellet intake (163.4 vs. 110.2 g/d) and live weight (3062 vs. 2705 g) than those reared in open-air pens. At slaughter the open-air rabbits had higher ($P<0.05$) proportion of hind part (34.9 vs. 33.1%) but the dressing out percentage was similar (about 60%). The open-air rabbits had lower ($P<0.05$) percentage of dissectible fat in reference carcass (1.66 vs. 5.29%) and proportion of muscle in hind leg (79.3 vs 81.9%) and their femur had higher diameter. The housing system had no effect on dressing out percentage, viscera proportion and meat pHu.

Keywords: Rabbit, Growth, Carcass, Housing system, Organic.

INTRODUCTION

In recent years consumers' interest in products derived from free-range or organic production systems has been steadily increasing in Europe. Consumers' preference for these products is related with a perceptual higher quality and security of meat coupled with high standards of animal welfare. To meet the expectations of consumers, several researchers have studied alternative production systems for growing rabbits. Cages with different sizes, different stocking densities and group sizes, pens with litter, open-air pens and movable cages have been proposed, although in most cases there is little scientific evidence supporting these options. Verga (2000) and Pinheiro and Mourão (2007) reviewed the main results of the studies in this field. Generally, the more extensive housing systems allow more space and freedom of movement to rabbits, but increase the sanitary risk, impairing economic results and food safety. According to several reports the housing system affects body weight, carcass traits and sometimes the meat quality. Housing systems in floor pens or colony cages seem to reduce stress and aggressive behaviour of the animals (Maertens and Van Herck, 2000), however, mortality rate is increased and growth rate, feed intake, feed efficiency, dressing out percentage and meat quality decreased (Lambertini *et al.*, 2001).

The aim of this experiment was to study the effects of housing systems (cages or open-air pens) on growth performances, carcass characteristics and meat quality.

MATERIALS AND METHODS

Animals and experimental design

The study was carried out in May of 2006 at the experimental rabbit farm of Animal Production

Department of Universidade de Trás-os-Montes e Alto Douro (UTAD) in Vila Real, Portugal. A total of 96 hybrid rabbits (New Zealand White×Californian) from both sexes were used during 4 weeks from 59 to 87 days of age. In the beginning, rabbits were weighted, tattooed and randomly assigned to the two treatments. In the treatment “cages”, 48 rabbits were reared in a standard intensive housing system. Rabbits were kept in 12 cages (0.5×0.6×0.35 m) located in a temperature-controlled room and received daily 12h of light (8:00 to 20:00). In the treatment “open-air”, 48 rabbits were reared in open-air pasture pens (20×9 m), with natural environment. During the study, rabbits fed *ad libitum* with a commercial pelleted diet (16.3% crude protein; 3.3% ether extract; 32.3% NDF) and had free access to water. In the open-air treatment, rabbits had also access to the natural pasture, but its composition and ingestion was not measured. At the end of growing period (87 d), 24 rabbits (12 rabbits/treatment) were slaughtered and the carcasses were obtained according to the World Rabbit Science Association (WRSA) norms (Blasco and Ouhayoun, 1996).

Growing trial

During the growing trial, individual body weights of rabbits were recorded weekly. The intake of pelleted diet was recorded weekly by cage or pen and average feed intake of rabbits was determined.

Carcass characteristics

Chilled carcass weight was obtained 24 h *post-mortem*, and dressing out percentage (chilled carcass weight/live weight) was determined. Carcasses were dissected according to the WRSA norms (Blasco and Ouhayoun, 1996) to obtaining the reference carcass. In each carcass, bone and meat of right hind leg were dissected and weighted and meat to bone ratio was calculated. Weight, length and diameter of femur were also measured.

The carcass colour was determined on the surface of the left *m. biceps femoris* at 24 h *post-mortem*. Meat colour was measured on the transversal section of this muscle. Carcass and meat colour were measured using a Minolta CR-300 Minolta Chromameter (Minolta Camera, Osaka, Japan), and expressed in the CIELAB dimensions of lightness (L*), redness (a*) and yellowness (b*). Ultimate pH was measured at 24 h *post-mortem* (pHu) with a portable pH meter in the right *m. biceps femoris* penetrating 5 mm.

Statistical analysis

Data were analysed using the ANOVA procedures, when the treatment is the variable. Means were compared using the Tukey test. Statistical significance was accepted at $P < 0.05$ and was performed with JMP 5.0.1 (2003) software. Mortality was not statistical analysed due to its reduced number.

RESULTS AND DISCUSSION

The results of the growth trial are summarized in Table 1. Rabbits reared in cages, showed a final live weight significantly ($P < 0.05$) higher (more 357 g or 13%) than open-air rabbits. During the growing period (59 to 87 d), the weight gain and pellet intake were also significantly higher in rabbits reared in cages. In this system, the weight gain increased by 34% and the feed intake increased by 48%. Probably, the lower intake of pelleted diet in rabbits reared in open-air system is partially due to the intake of pasture, since animals have access to it. However, the intake of pasture was not determined. The effects of treatments obtained in this experiment are in accordance with that ones observed by Lambertini *et al.* (2001) and McNitt *et al.* (2003). The open-air pens provide more space for animals, increasing the requirements of energy to maintenance and reducing the growth. According to Maertens and Van Herck (2000), the increase of locomotor activity plays a role in the lower weight gain. The lower weight gains of the open-air rabbits may also result of grazing, which reduce the intake of pelleted diet resulting in a lower nutrient intake (McNitt *et al.*, 2003). During the study 2 animals in cages and 1 in open-air death.

Table 1: Effect of breeding system on growth performances of growing rabbits

	Housing System		SEM	P-value
	Open-air	Cages		
Rabbits (n)	48	48		
Live weight at 59 d (g)	1752	1785	14	0.25
Live weight at 87 d (g)	2705	3062	48	<0.001
Weight gain 59-87 d (g/d)	34.2	45.9	0.8	<0.001
Rabbits (n)	1	12		
Pellet feed intake 59-87 d (g/d)	110	163	4	<0.001

SEM – Stand error of mean

The effects of treatment on carcass characteristics at 87 d are presented in Table 2. The dressing out percentage was not affected by treatment (59.9 vs. 60.7), which agree with the results of Maertens and Van Oeckel (2001). However in other works was observed lower dressing out percentage in rabbits reared in pens (Metzger *et al.*, 2003; Dal Bosco *et al.*, 2000). Probably, the low number of rabbits analysed per treatment contributed to this lack of effects. In our trial open-air rabbits showed a higher reference carcass percentage, as consequence of increase of head weight. The results of weight of viscera obtained in this work are higher than those presented by Pascual and Pla (2007), probably due to the lower age and weight of these rabbits. In fact, it is known that growth rate and age affect the development of specific tissues and organs.

The content of dissectible fat in carcass in the open-air rabbits was only 1/3 of that found in the cage group. Also Dal Bosco *et al.* (2000) and Metzger *et al.* (2003) obtained carcasses with a lower lipid content in rabbit logged in open-air or indoor pens than in that ones reared in cages. This effect could be related with the increase of locomotor activity energy expenditure in thermoregulation (Verga, 2000) and lower feed intake (Maertens and Van Herck, 2000) in open-air systems.

Table 2: Effect of housing system on carcass characteristics of rabbits at 87 d

	Housing System		SEM	P-value
	Open-air	Cages		
Rabbits (n)	12	12		
Live weight (g)	2717	3091	47.53	<0.001
Dressing out percentage (% LW)	59.9	60.7	0.32	0.19
Reference carcass				
weight (g)	1333	1490	23.03	<0.001
percentage of carcass	81.96	79.33	0.33	<0.001
Head (% carcass)	7.31	6.63	0.11	0.01
Liver (% carcass)	6.26	6.74	0.16	0.14
Kidneys (% carcass)	1.12	1.11	0.03	0.90
Lungs (% carcass)	1.87	1.94	0.05	0.53
Dissectible fat (% reference carcass)	1.66	5.29	0.41	<0.001
Hind part (% reference carcass)	34.94	33.10	0.24	<0.001
Meat/bone of hind leg	4.20	5.01	0.14	0.003
Femur				
weight (g)	14.48	14.52	0.26	0.952
length (mm)	86.11	86.58	0.88	0.803
diameter (mm)	7.23	7.02	0.05	0.028
Carcass colour				
L*	50.72	53.12	0.50	0.013
a*	3.73	3.66	0.42	0.94
b*	5.22	4.98	0.46	0.80
pHu	5.96	6.01	0.04	0.49

SEM – Stand error of mean

LW: live weight; L*: lightness; a*: redness; b*: yellowness; pHu, pH measurement at 24 h post-mortem

The open-air rabbits have higher proportion of hind part (34.9 vs. 33.1), hind leg with less meat, higher bone and lower meat/bone ratio and diameter of femur. The obtained results are in accordance with Dal Bosco (2000) and are related to the increase of exercise allowed by the increase of available space in open-air system. However, Metzger *et al.* (2003) did not observed differences between muscles and meat/bone ratios of hind part of rabbits logged in pens or cages.

The carcass colour of open-air group showed a lower lightness (L*) than that one of rabbits kept in cages (50.72 vs. 53.12; P<0.05). Dal Bosco *et al.* (2002) observed higher values in rabbits reared in closed parks than in rabbits reared in traditional cages. However, the comparison with this work is difficult, since rabbits were not reared in the same conditions; in our work rabbits were reared in open-air pens with more space. The treatment had no effect on meat pHu, which is in accordance with Metzger *et al.* (2003). The observed pHu of rabbit meat agree with Pascual and Pla (2007).

CONCLUSIONS

The main effect of rearing rabbits in open-air pens is the reduction of growing performances. These rabbits have also higher proportion of hind part, lower fat content in carcass and meat:bone ratio in hind leg. In future it will be necessary to investigate the effects of housing system on carcass characteristics during a more extended period and to study other meat characteristics to determinate whether the poor performances are compensated by the increase of meat quality.

REFERENCES

- Blasco A., Ouhayoun J. 1996. Harmonization of criteria and terminology in rabbit meat research. Revised proposal. *World Rabbit Sci.*, 4, 93–99.
- Dal Bosco A., Castellini C., Bernardini M. 2000. Productive performance and carcass and meat characteristics of cage-or pen-raised rabbits. *World Rabbit Sci.*, 8, 579-583.
- Dal Bosco A., Castellini C., Mugnai C. 2002. Rearing rabbits on a wire net floor or straw litter: behaviour, growth and meat qualitative traits. *Livest. Prod. Sci.*, 75, 149–156.
- Lambertini L., Vignola G., Zaghini G. 2001. Alternative pen housing system for fattening rabbits: effects of group density and bitter. *World Rabbit Sci.*, 9, 141-147.
- Maertens L., Van Herck A. 2000. Performance of weaned rabbits raised in pens or in classical cages: first results. *World Rabbit Sci.*, 8, 435-440.
- Maertens L., Van Oeckel M.J. 2001. Effet du logement en cage ou en parc et de son enrichissement sur les performances et la couleur de la viande des lapins. In: *Proc. 9^{èmes} Journ. Rech. Cunicole, Paris, France, 31-34.*
- McNitt J., Way R., Way M., Forrester-Anderson I. 2003. Growth of fryers reared and (or) finished using controlled grazing in movable pens. *World Rabbit Sci.*, 11, 189-198.
- Metzger Sz., Kustos K., Szendrő Zs., Szabó A., Eiben C.S., Nagy I. 2003. The effect of housing system on carcass traits and meat quality of rabbit. *World Rabbit Sci.*, 11, 1-11.
- Pascual M., Pla M. 2007. Changes in carcass composition and meat quality when selecting rabbits for growth rate. *Meat Sci.*, 77, 474-481.
- Pinheiro V., Mourão J.L. 2007. Sistemas de produção alternativos na engorda de coelhos. In: *Proc. II Congresso Ibérico de Cunicultura da APEZ e ASESCU, 2007 June, Vila Real, Portugal, 163-173.*
- Verga M. 2000. Intensive rabbit breeding and welfare: development of research, trends and applications. *World Rabbit Sci.*, 8, 491-509.