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### Behaviour and production of fattening rabbits in colony cages, with and without environmental enrichment

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κίας 70 ημερών) και στην τρίτη περίοδο (ηλικίας 83 ημερών) τα ζώα στα εμπλουτισμένα κλουβιά έδειξαν εντονότερη διατροφική συμπεριφορά και επίπεδα τυφλοτροφίας ( $P < 0.05$ ). Στην παρούσα έρευνα τα αποτελέσματα δείχνουν ότι το να κρεμάσεις ένα κομμάτι ξύλου από την οροφή του κλουβιού στα κουνέλια μπορεί να βελτιώσει τη φυσιολογική τους λειτουργικότητα, να αυξήσει το βάρος του σώματός τους, χωρίς όμως να μειώσει το επίπεδο υγείας τους. Ως αποτέλεσμα, ο εμπλουτισμός του κλουβιού μπορεί να βελτιώσει τη συμπεριφορά και την ευζωία των κουνελιών που διατηρούνται σε κλουβιά.

**Λέξεις ευρετηρίασης:** κουνέλια, εμπλουτισμός περιβάλλοντος, συμπεριφορά, παραγωγή

Απόδοση της περίληψης στην ελληνική γλώσσα από **Ε. Ξυλούρη**, Τμήμα Ζωικής Παραγωγής, Γεωπονικό Πανεπιστήμιο Αθηνών, Ιερά Οδός 75, 118 55, Αθήνα.

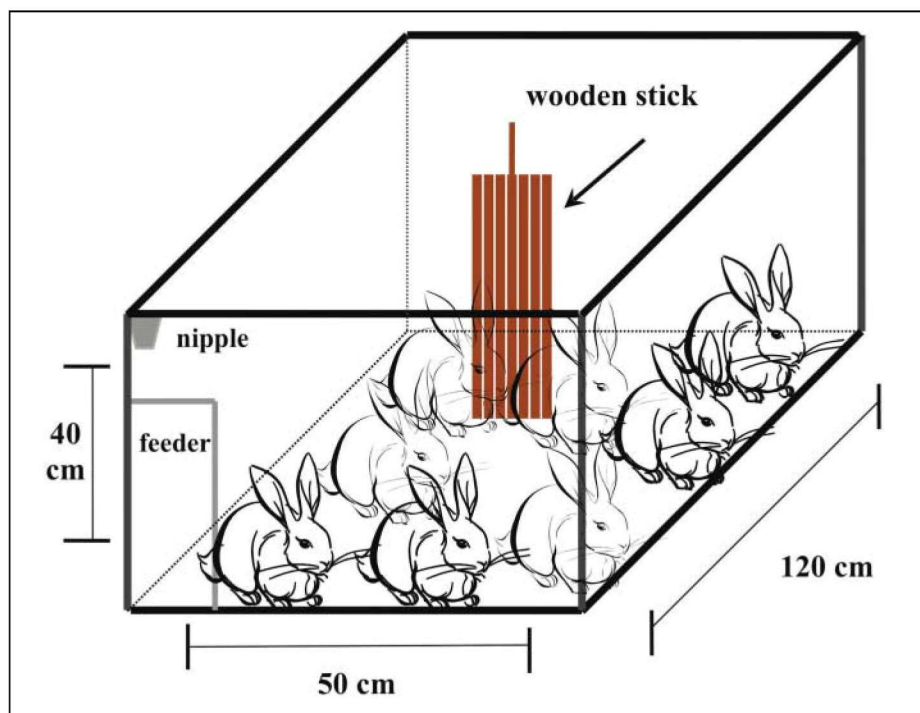
## 1. INTRODUCTION

Fattening rabbits are conventionally housed singly or, more frequently, in two animals per cage, in cages of standard dimensions, according to the local tradition. Presently in Europe no EU Directives exist on cage dimensions for these animals, while in some countries local Codes indicate the housing dimensions for rabbits (DEFRA, 1987; WRSA (German Branch, 1991). Moreover, guidelines have been stated also in Switzerland (Swiss Order on Animal Protection, 1991; Bigler and Oester, 1996). At the European level, however, rabbits' husbandry has recently deserved attention too; in fact, a working group (COST Action 848 UE, 1999) has been constituted on rabbits' welfare. In farmed rabbits, the conventional housing system in cages may sometimes affect negatively animals' welfare, both for breeding and for fattening rabbits. The main problems, such as changes in locomotion, presence of stereotypes, space-time disorders, disturbed sexual and maternal behaviours, low conception rate and parental care (Stauffacher, 1992), are mainly related to the type of housing, in particular the quantity and quality of the available space, the handling and management by the stockman, the type of reproduction and the reproduction rhythms for the doe, the environment given to the does and the kits, the type of feeding regimen. Moreover, rabbits are social animals living in colony (Gibb, 1993) and to maintain this condition also in intensive rabbits' rearing could improve their possibility to have adequate social contacts. No abnormal behaviours have been shown in group-housed females (Gunn and Morton, 1996), while group housed males may become more aggressive when reaching sexual maturity (Harkness and Wagner, 1989). In fact, in fattening rabbits, some researchers (Crimella et al.,

environmental enrichment might affect their behaviour and increase their welfare.

**Key words:** rabbit, environmental enrichment, behaviour, production

1987; Bigler and Oester, 1996; Rommers and Meijerhof, 1998) observed fights among the rabbits after 70 days of age. Besides the cage dimensions, also the lack of stimuli may cause welfare problems for rabbits, as well as for other species (Hughes and Duncan, 1988). In fact, boredom may induce physiological and behavioural stress reactions, sometimes leading to health problems too (Lawrence and Rushen, 1993; Fraser and Broom, 1994; Moberg and Mench, 2000). Stereotypes (Mason, 1991), due to limitations in the ethogram, such as barbiting, excessive grooming, wire gnawing, pawing against the cage wall and playing with the water nipple, have been shown in rabbits (Hansen and Berthelsen, 2000; Verga, 2000). In order to reduce stress problems due to the lack of stimuli, it is worthwhile to study appropriate environmental design, considering both the available space and number of animals (Morisse and Maurice, 1997), and the enrichment, which may be introduced into the rearing environment (Brooks et al., 1993; Huls et al., 1991). According to Newberry (1995) and Newberry and Estevez (1997), environmental enrichment may be defined as 'an improvement in the biological functioning of captive animals resulting from modifications to their environment'. In fattening rabbits, this improvement may be shown measuring their behaviour, health status and production too, i.e. growth rate and feed conversion ratio, which may be a consequence of an improved welfare for these farmed animals and which may constitute an important result for the farmers too, thus inducing them to improve the rearing environment for these animals. Moreover, providing environmental enrichment to farmed rabbits may 'improve the public image of animal production' and 'increase economic returns by boosting growth rate or feed conversion efficiency (Gvoryahu et al., 1989). Housing



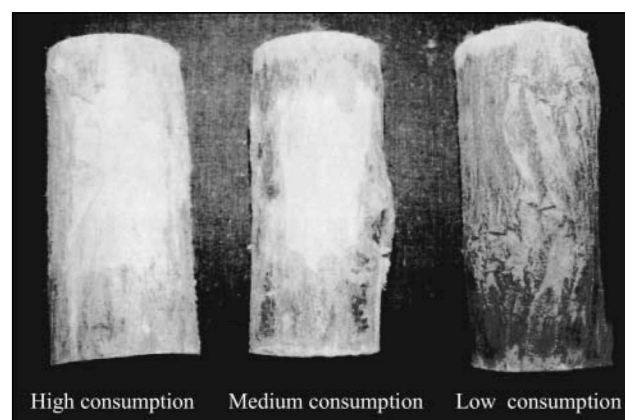
**Figure 1.**  
Graphic representation of colony cage  
for fatteners  
(8 rabbits per cage; density = 750 cm<sup>2</sup>  
per animal)

enrichment for rabbits may be obtained both by modifying the rearing system and/or introducing some alternative stimuli into the environment. The effects of the provision of objects has been studied too in individually housed rabbits: hay, compared to grass-cubes, gnawing sticks, a box or nothing, seems to be more effective in lowering abnormal behaviour, although rabbits given grass-cubes show higher growth rates (Lidfords, 1997). The aim of this study was to investigate the effect of the provision of environmental enrichment, i.e. a wooden stick hanging down from the cage ceiling, on behaviour and production of fattening rabbits colony caged.

## 2. MATERIALS AND METHODS

### 2.1 Animals and Experimental Treatments

The trial was carried out in an intensive rabbit farm in the North West of Italy, during a 3-month period (June-August). 96 animals (commercial hybrids) were randomly distributed in colony metal cages (12 cages, 8 animals per cage – cage size: 50x120x40 cm - density: 0.750 cm<sup>2</sup> per animal – figure 1) in *semi plain-air* conditions at 55 days of age. In 6 cages a wooden stick (*Robinia pseudoacacia*) (figure 2) hanging down from the cage ceiling was placed (treatment group, n=48); in the other 6 cages (control group, n=48) there was nothing else than the equipment for providing water and food. The animals were fed by a commercial compound feed (crude protein 16%, crude fibre 17.5%,



**Figure 2.** Wooden stick: *Robinia Pseudoacacia* (length: 20 cm – diameter: 10 cm)

crude fat 3.2%), offered *ad libitum*, and had free access to water (nipple drinkers). Regarding the price of the wooden sticks, it is not easy to have a definite value. In our experimental conditions, the type of wood used (*Robinia pseudoacacia*) is very frequent and cheap in the region of North of Italy, where the trial was assessed.

### 2.2 Behavioural observations

Animals' behaviour was video-recorded during 72 hours (24 hours for 3 days) starting at 55 days of age, at 70 days of age and before slaughtering, at 83 days of age. The video recording covered 48 rabbits for each treatment (environmental enrichment and control



group). Behaviour was analysed using a scan sampling method (Martin and Bateson, 1993) every 10 seconds during the whole observation time.

The following behavioural parameters were recorded, according to Gunn and Morton (1995):

- *active movement*: quickly running around in the cage;
- *aggressive behaviours*: biting with or without injuries;
- *eating*: eating rabbit pellets from the hopper;
- *drinking*: ingesting water;
- *caecotrophy*: ingesting faeces directly from anus;
- *freezing*: the forelegs are forward, the hind legs staying in place and the heels are visible behind the body;
- *gnawing*: gnawing the bars of the cage;
- *self-grooming*: licking, scratching or nibbling of the body;
- *lying*: resting with trunk on ground, hind limbs tucked under the body, the forelimbs lying under the body or stretched forward from the body.
- *lying stretched*: resting with body trunk on ground, hind limbs outstretched and belly exposed;
- *smelling*: smelling at another rabbit and/or at the wooden stick.

### 2.3 Animal performance and body injuries

During the experimental period, the following productive parameters were checked: weight at 55 and at 70 days of age, weight at slaughtering (85 days of age), daily weight gain, mortality rate during the fattening period, body injuries at the end of the fattening period, carcass weight and carcass yield.

To detect the body injuries, due to fights among the animals, we utilised the classification of Bigler and Oester (1996) as follows:

- minor injuries: small and superficial injuries (superficial abrasions and so on);
- medium injuries (problematic): more relevant injuries; they take longer to heal also if the animals show no obvious reactions of pain;
- serious injuries (very problematic): large and inflamed or purulent injuries that heal badly; the animals often show reactions of pain.

### 2.4 Statistical analysis

The productive data were submitted to Analysis of Variance (General Linear Model by SAS, 1999) using the treatment (wooden stick) as main effect for the productive parameters and the initial body weight as a covariate.

The behavioural parameters were analysed using the Analysis of Variance (Npar1way Procedure – Wilcoxon scores) (SAS, 1999).

## 3. RESULTS

### 3.1 Behavioural observations

In the first period (55 days of age), the enriched rabbits were more active than the control ones; in detail, the behaviours lying and lying stretched were significantly lower ( $P < 0.001$  and  $P < 0.05$ , respectively). This difference could be linked to the new environment in the cage (presence of a wooden stick). Furthermore, the enriched rabbits showed a trend to higher feeding and caecotrophy activities, maybe linked to a total higher activity. Also, in the second (70 days of age) and the third period (83 days of age), the enriched rabbits showed higher feeding behaviour and caecotrophy levels ( $P < 0.05$ ; figure 3). Rabbits reared in cages with the presence of the environmental enrichment showed a high percentage of wood gnawing (80%) during the whole experimental period; in the last period, environmental enriched rabbits showed a significant reduction of the bar gnawing compared to the control ones.

### 3.2 Animal performance and body injuries

The total daily weight gain ( $49.6 \pm 2.7$  g vs  $46.18 \pm 5.6$  g) and weight at slaughtering ( $2973.18 \pm 34.09$  g vs.  $2834.68 \pm 34.45$  g,  $P \leq 0.01$ ) were heavier in enriched caged rabbits than in control groups. The carcass yield was not different between the groups (62.2%). No injuries were detected on the carcass surface during the slaughter processing on both the experimental and control groups. No mortality was observed apart from only one rabbit in the control group.

## 4. DISCUSSION

### 4.1 Behavioural observations

In the first period, rabbits with environmental enrichment were more active, thus indicating that the effect of wooden stick could be positive already at this stage. In fact, the rabbit activities were directed towards nutrition; also the caecotrophy and exploration activities were increased in rabbits housed in cages with environmental enrichment, although not significantly. In the second period, we found some behavioural differences, too. Rabbits without wooden stick rested more; it could be explained by reduced activity due to boredom. In the third period, the effect of the environmental enrichment probably reduced the stress effects due to the environmental hypo-stimulation. Rabbits without wooden sticks showed more gnawing bars, which could be a chronic stress indicator (Stauffacher, 1992), as well as they seemed to find alternative activities, such as smelling. This behaviour could be an exploration activity and/or a beginning of aggressiveness towards the other animals (Bigler and Oester, 1996). Furthermore, as regards the

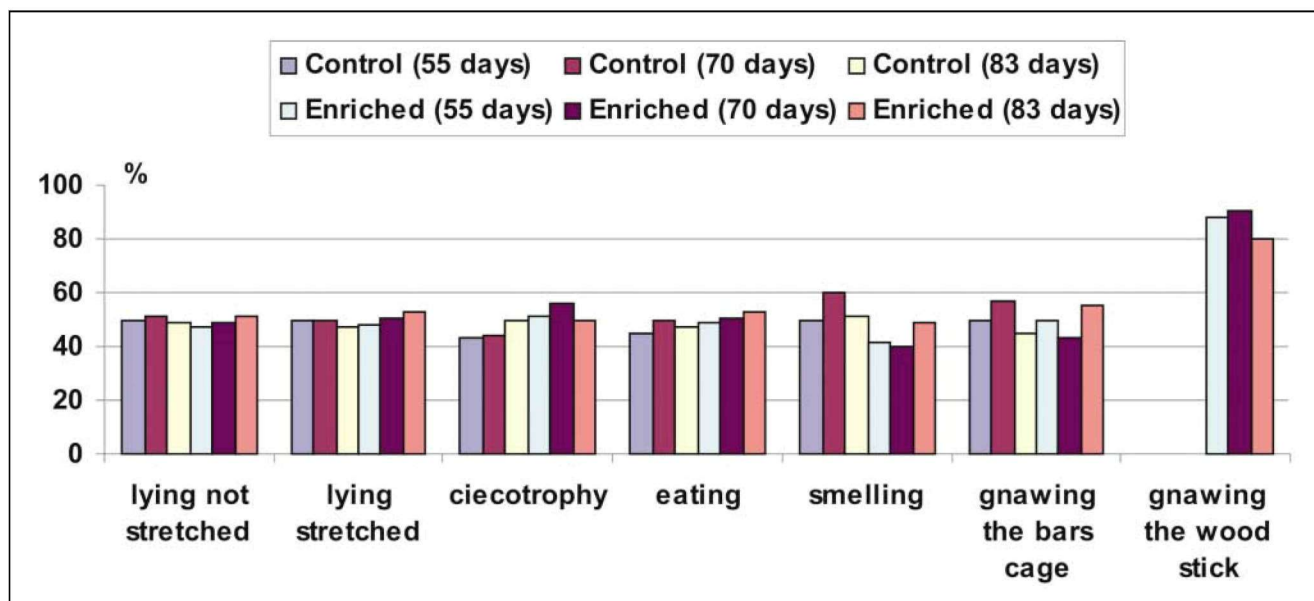


Figure 3. Behavioural parameters (frequency) at 55, 70 and 83 days of age divided per treatment and control group.

duration of the effect, Maertens and Van Oeckel (2001), similar as Huks et al. (1991) and Brooks et al. (1993), found out that rabbits showed interest in wooden sticks over a long period, although the intake was low, similar as found also by Jordan and Stuhec (2002).

#### 4.2 Animal performance and body injuries

Daily weight gain ( $49.6 \pm 2.7$ g vs  $46.18 \pm 5.6$ g) and weight at slaughtering ( $2973.18 \pm 34.09$ g vs  $2834.68 \pm 34.45$ g,  $P \leq 0.01$ ) were heavier in enriched cages than in control groups. On the contrary, the carcass yield was not different between the groups (62.2%). Jordan and Stuhec (2002) reported that providing wood for gnawing as an enrichment method did not significantly influence live weight gain and carcass weight. No injuries were detected on the carcass surface during the slaughter processing on both the environmental and control groups. Bigler and Oester (1996) reported that the frequency of aggressive behaviour increased with larger group size: in groups with 10-15 animals aggressive encounters occurred less than in groups with 16-30 and 40 animals. Mirabito et al. (1999a) found that the group size (2 or 6 animals per cage) did not affect the performance. The same authors (Mirabito et al., 1999b) reported better results in cages with 6 rabbits; thus, sometimes the results were fluctuating. In other trials the group size and the stocking density affected the rabbits' performance and the mortality rate (Eiben et al., 2001).

Morisse and Maurice (1997) found that, in fattening rabbits slaughtered before sexual maturity, dominance and sexual behaviour leading to aggressive encounters

are uncommon and allow the rearing of mixed sexes without major problems. In young animals, behavioural patterns are only slightly affected by stocking densities. Moreover, at 10 weeks of age, social interactions and locomotory activities are reduced beyond 15 rabbits per square metre (i.e.  $38 \text{ kg/m}^2$ ). Taking into consideration the behavioural pattern of rabbits kept in intensive conditions, it is suggested that the animal welfare could be improved if stocking density does not exceed  $40 \text{ kg/m}^2$  (Morisse and Maurice, 1997). The housing system tested in this study, which consisted of colony cages with 8 animals per cage corresponding to a density of  $13 \text{ animals/m}^2$  and  $38.6 \text{ kg/m}^2$ , may avoid aggressive interactions among the rabbits.

#### 5. CONCLUSIONS

In the present study the environmental enrichment reduced the stress effects due to the lack of stimuli; the control animals showed higher stereotypes, i.e. bar gnawing. Thus, the object given to the animals may represent, for rabbits, an adequate kind of environmental enrichment, fulfilling some specific needs of these animals.

Considering the wooden sticks enrichment, Jordan et al. (2004) tested the performance of rabbits for three different types of wooden stick. They found that the most eaten one was Norway spruce (*Picea abies*) than sticks made of lime (*Tilia cordata*) and oak (*Quercus robur*). In our study *Robinia pseudoacacia* seem to be very adequate.

Some other strategies concerning the environmental



enrichment have been tested in other researches, for example, utilising small wooden sticks hanging from the ceiling of the cage or inserting straw or toys on the wall of the cage (Morise et al., 1999; Maertens and Van Oeckel, 2001). Anyway, these types of environmental enrichment need further evaluation.

The reduction of abnormal behaviours together with

increased other activities, such as caecotrophy and feeding and improved performance, may also indicate an improvement in welfare conditions. It is possible to conclude that environmental enrichment is not important only from the animals' point of view, but also from the farmers' one, improving the public image of intensive rabbit rearing. □

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