EFFECT OF ENVIRONMENTAL ENRICHMENT AND GROUP SIZE ON BEHAVIOUR AND PRODUCTION IN FATTENING RABBITS

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ABSTRACT

During recent years the analysis of the rabbits' welfare has received increasing attention. Many scientific investigations have been carried out on the effects of alternative housing systems on productive performance, meat quality and welfare of rabbits. Intensive rabbit breeding normally involves the use of small collective cages housing 2 to 8 rabbits according to the surface area of the cage and to the local tradition. The housing system should allow adequate social contacts because rabbits are social animals living in colony; moreover, environmental enrichment may allow the animals to perform their natural behaviors, thus possibly improving their welfare. The aim of this research was to study the effects of group size and environmental enrichment on the behaviour and production of 216 hybrid fattening rabbits (*Oryctolagus cuniculus*). We compared behaviour (time budget and reactions to specific behavioural tests: "tonic immobility" and "emergence test") and weight gain of fattening rabbits housed in cages with a different number of animals (2, 3 or 4 per cage) but with the same density (714 cm^2 per cage). Moreover, half of the cages were enriched using a wooden stick. Wooden stick and number of animals per cage had no effect on weight gain or the reactions in the behavioural tests. No statistically significant differences between day and night on behaviour were apparent. The interaction with a wooden stick was significantly higher at the beginning of the fattening period. Principal component analysis performed on the whole period showed significant differences according to the treatments on the following behaviours: movement, sitting, lying, and allo-grooming. Increasing the number of rabbits per cage and introducing a wooden stick seemed to affect movement frequency and social interactions. Rabbits housed 3 and 4 per cage showed less lying behavior and higher movement and sitting; thus, the larger functional space could allow rabbits to perform more natural behaviors compared with rabbits housed 2 per cage. Environmental enrichment is related to higher allo-grooming, which could indicate a social behavior related to pheromonal olfactory stimulation and mutual recognition.

Key words: Rabbits, Behaviour, Environmental enrichment, Density, Group size.

INTRODUCTION

Increasing concern towards animals welfare in livestock farming has led in recent years to studying alternative housing systems. Although there are currently no European Directives regarding housing and management for farmed rabbits, they have been established for rabbits used as laboratory animals (Verga *et al*., 2007). The conventional housing system in cage may negatively affect rabbits' welfare (Morisse *et al*., 1999). To aim at reducing stress due to the lack of stimuli and to improve rabbits' welfare, it is necessary to study appropriate environmental design, considering both the available space and the number of animals living in it. Additionally, the rearing environment can be enriched by a variety of strategies (Newberry, 1995; Lidfords, 1997; Hansen *et al*., 2000) such as: modifications of the rearing system in which places to hide and rest are added to the cage (e.g., elevated platforms or alternative floors) (Ruis, 2004). Roughage food objects such as hay (Berthelsen and Hansen, 1999; Lidfors, 1997), grass cubes or gnawing sticks (Love, 1994) can also be added. Measurable stress indicators for rabbits are behavior, physiology, health and production. To assess rabbits' welfare

specific behavioral tests can be used, for example the 'emergence' and the 'tonic immobility' tests aimed at measuring fear in a new environment or towards humans (Verga *et al*., 2007).

The aim of this research was to study the effects of group size and environmental enrichment on behaviour and production.

MATERIALS AND METHODS

The study was carried out in a commercial rabbit farm, in the North-West of Italy, equipped with an air control temperature system. We did two equal trials during the spring. One hundred and eight commercial fattening hybrid rabbits of both sexes were used in each trial. The rabbits were divided into three different cages, all with a similar density (714 cm^2/rabbit): six cages A (68 cm, 41.5 cm, h 29 cm) with 4 rabbits and with environmental enrichment and six AC, of the same size, with 4 rabbits as control group, without any environmental enrichment, six cages B (51 cm, 41.5 cm, h 29 cm) with 3 rabbits and with environmental enrichment and six cages BC, of the same size and number of animals, as the control group, six cages C (51 cm, 28 cm, h 29 cm) with 2 rabbits and with environmental enrichment and six cages CC with the same characteristics but, as a control group, without any environmental enrichment. The environmental enrichment consisted of a wooden stick (*Robinia Pseudoacacia,* length: 20 cm – diameter: 6 cm) hanging from the ceiling of the cage.

The rabbits were transferred to the cages at the age of forty days. The fattening period lasted up to the age of seventy-nine days. Each cage was equipped with a feeder and a nipple drinker; feeding (commercial fattening diet) and water were provided *ad libitum*.

Effects of breeding conditions on fattening were fitted using the GLM procedure of SAS (1989) with a factorial univariate linear model for repeated measures, wooden stick and number of rabbits per cage being the covariates. The following variables were recorded: mortality rate, weight gain, behaviour during 24 hours (time budget) and fear towards a new environment and towards humans, using two specific behavioral tests: emergence test (ET) and tonic immobility (TI) (Hansen *et al*., 1993; Ferrante *et al*., 2005). The rabbits' behaviour was video recorded 4 days after weaning, 4 days during the middle of fattening period and 4 days before slaughter. The following behaviours were analysed: rest (sitting and lying); ingestion (feeding and drinking); comfort (self-body care); social (sniffing, biting, allo-grooming); locomotor (walking); interaction with wood (sniffing, gnawing the wood stick); stereotypies (gnawing the bars of the cage). Thus, each cage was observed for 24 hours throughout 12 days in each trial. During the experiment individual live weight was recorded at weaning (40 days of the age), at 61 days of age and at slaughter (79 days of age). At the same age, every rabbit was subjected to the emergence test, then to the tonic immobility test and after that it was weighed.

A univariate analysis of productive and behavioral variables was performed in order to evaluate differences according to trials, to experimental groups and differences between day and night. Moreover, principal component analysis (PCA), using PRINCOMP procedure of SAS (1989), was performed on the whole dataset of behavioural variables. Regarding the emergency test, effects of rearing conditions on latency to leave the box were fitted with a univariate linear model for repeated measures, wooden stick and number of rabbits being the covariates, while "number of attempts to leave the box" were fitted with a Poisson linear model for repeated measures using the GENMOD procedure of SAS with logarithmic link function and the same covariates. Regarding the immobility test, effects of rearing conditions on tonic immobility time were fitted using the GLM procedure of SAS (1989) with a factorial univariate linear model for repeated measures, wooden stick and number of rabbits being the covariates. Effects of breeding conditions on "number of inductions" were evaluated fitting a Poisson linear model for repeated measures using the GENMOD procedure of SAS, with logarithmic link function, having wooden stick and number of rabbits as covariates.

RESULTS AND DISCUSSION

No statistical differences were found among the treatments (enriched cages vs. not enriched cages) and the number of animals per cage. The final weight range was 2519-2688 g. These results support the findings of previous studies showing that environmental enrichment and housing have a low effect on productive performance and meat quality in rabbits (Verga *et al*., 2004). The mortality rate was negligible for all the treatments. Univariate analysis of behavioural variables showed: a) no statistical differences (P>0.05) between day and night; b) wood stick interactions are more frequent (P<0.05) during the first period, perhaps indicating a habituation process (Figure 1).

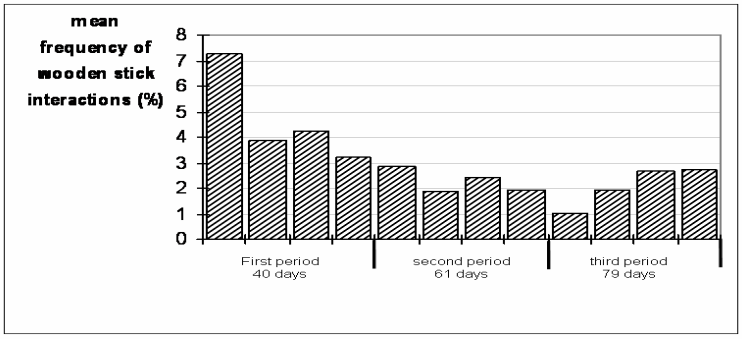

Figure 1: Mean frequency of wood stick interactions

PCA analysis of the ethogram showed significant effects of rearing conditions on some behaviours. The first three principal components explained about 40% of the total variance (Table 1).

Table 1: First three eigenvalues of behavioural test correlation matrix

Component	Eigen value	Variance (%)	Cumulative (%)
I	1.31	14.6	14.6
II	1.27	14.1	28.7
III	1.07	11.8	40.5

First principal component (14.6% of total variance) was positively related to lying and negatively related to sitting and movement. This component discriminates among number of rabbits per cage and showed that an increased number of rabbits is positively related to those behaviours (Figure 2 and Table 2).

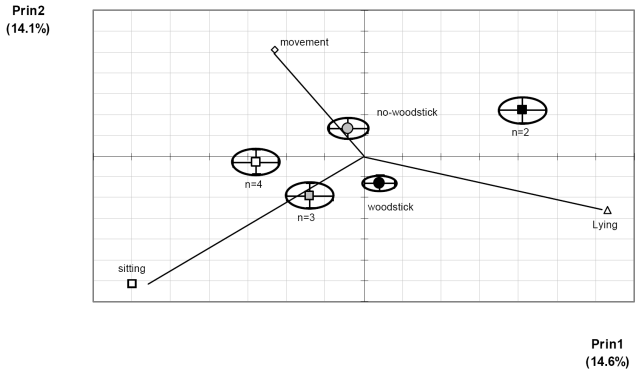

Figure 2: First two principal component plot

Second principal component (14.1% of total variance) is negatively related to lying and "sitting" and positively related to movement. This component discriminates among number of rabbits per cage (Figure 2 and Table 2) showing that increased number of rabbits is positively related to sitting and movement. These results could be related to the higher possibility of movement due to the higher functional space in the cages housing 3 or 4 rabbits compared to the ones housing 2 rabbits.

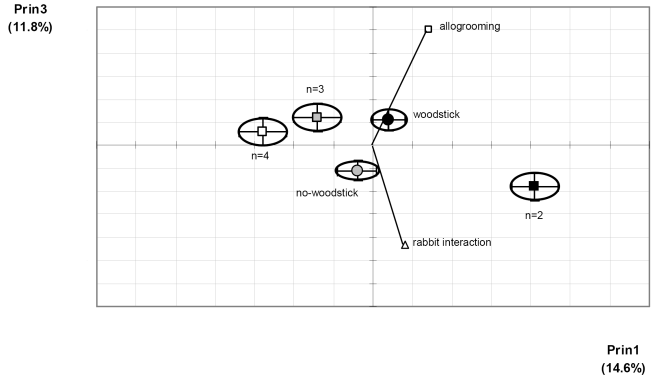

Figure 3: First and third principal component plot

Third principal component (11.9% of total variance) counterpoises allo-grooming to the other social interactions (Figure3). It is related to different types of social activity and showed that the presence of a wood stick is positively related to allo-grooming while the absence of the wood stick matches with increased number of the other social interactions, although no real aggressive behaviour was observed.

Table 2: Eigenvector of correlation matrix of behavioural variables and least square estimates of group's scores

Variable	*Prin1*	*Prin2*	*Prin3*
Sitting	-0.61	-0.66	0.14
Movement	-0.25	0.51	-0.040
Lying	0.64	-0.26	-0.25
Allogrooming	0.15	-0.089	0.50
Rabbit interactions	0.079	-0.0025	-0.43
Groups			
n=2	0.41	0.23	-0.18
n=3	-0.28	-0.036	0.065
n=4	-0.12	-0.20	0.12
Woodstick	-0.049	0.12	-0.12
no-woodstick	0.049	-0.12	0.12

The analysis showed no effects of treatment (P>0.05) on the reaction in the behavioural tests. The latency in the emergence test varied between 68-87.6 sec, while the duration of immobility tonic ranged between 33.7-60.7 sec.

CONCLUSIONS

When housed two per cage the total area available (functional space) does not allow rabbits to express many locomotor behaviors. In small cages few locomotor activities are seen, but increased rest and feed behaviors have been observed. In this research the higher functional space of cages housing three and four rabbits per cage allows the animals to move better compared to the rabbits housed two per cage.

Environmental enrichment may affect social behaviour increasing allo-grooming which could possibly be related to pheromonal olfactory stimulation. In the future, research should be addressed to clarify the real meaning of the social different interactions in fattening rabbits according to functional space, slaughtering age and environmental enrichment.

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