TEMPERATURE AND CAGE FLOOR ENRICHMENT AFFECT THE BEHAVIOR OF GROWING RABBITS

Siloto E.V.[1], Zeferino C.P.[1], Moura A.S.A.M.T.[1]*, Fernandes S.[1], Sartori J.R.[2], Siqueira E.R.[1]

[1]Departmento de Produção Animal, School of Veterinary Medicine and Animal Sciences, UNESP - São Paulo State University, 18618-000 Botucatu, SP, Brazil
[2]Departmento de Melhoramento e Nutrição Animal, School of Veterinary Medicine and Animal Sciences, UNESP - São Paulo State University, 18618-000 Botucatu, SP, Brazil
*Corresponding author: anamoura@fca.unesp.br

ABSTRACT

The effects of temperature and cage floor enrichment on some behavioral activities of growing rabbits and the effect of temperature on cage floor choice were investigated. Forty-eight rabbits from the Botucatu genetic group, weaned at 35 d of age, were housed at low density (1,500 cm^2), four per cage, in wire net cages up to 10 weeks of age. Cages were placed either in a natural temperature chamber or in a refrigerated one. In each chamber, half of the cages had part of the floor surface covered with a wooden board enriched with litter straw such that, in enriched cages, rabbits had free choice between the straw and the wire net floor. In all cages, rabbits had free access to water and feed on both sides of the cage. In enriched cages, the number of rabbits on the wire net floor and on the litter straw was recorded by scan sampling every 5 minutes in five 24-h observation periods carried out once a week over five weeks. The behavior of animals was evaluated in the same five 24-h observation periods. The mean daily temperature and relative humidity were higher in the natural temperature chamber than in the refrigerated one (23.6ºC and 78.7% vs. 20.6°C and 71.0%, respectively). In the natural temperature chamber, rabbits preferred the wire net floor over the litter straw (77.9 vs. 22.1%, $P<0.01$), whereas in the refrigerated chamber they did not show any preference (45.9 vs. 54.1%, $P=0.41$). Self-grooming was the most frequent behavioral activity observed (51.9%), whereas stereotypes were the least frequent (5.2%); exploratory and ludic activities and social interaction showed intermediate frequencies (20.6, 11.7 and 10.6%, respectively). A higher number of ludic and exploratory events were recorded in the enriched cages of both chambers, which may be associated with a higher degree of welfare. Stereotypes were less frequent in the refrigerated chamber; however, a higher incidence of stereotypic behavior was observed in non-enriched cages of both chambers. Self-grooming was also more frequent in non-enriched cages, which may be interpreted as an expression of stereotypy. In the natural temperature chamber, social interaction was higher in non-enriched cages, whereas no differences between enriched and non-enriched cages were observed in the refrigerated chamber. Although environmental enrichment with straw showed a favorable impact on rabbit welfare, its positive effects seemed to be less intense at higher temperature. Furthermore, higher temperature substantially decreased the proportion of rabbits that chose to stay on the straw in enriched cages.

Key words: Behavior, Cage floor, Ethology, Stress, Temperature.

INTRODUCTION

Consumers of animal derived products are concerned with animal welfare and management conditions (EFSA, 2005). Knowledge on the behavior of an animal species under a variety of different environmental conditions is a prerequisite to establish a welfare situation (Trocino and Xiccato, 2006). As domestication of rabbits occurred recently, in the Middle Ages according to Lebas *et al*., (1996), adaptation to a variety of production environments may not yet be satisfactory.

Environmental conditions and housing systems should be in accordance with the essential biological characteristics of the species. In tropical areas, environmental temperature along with relative humidity is the environmental factor that has the most profound impact on the efficiency of rabbit production and welfare conditions. The ranges of temperature and relative humidity recommended for laboratory rabbits (16 to 22°C and 30 to 70%; NRC, 1996) are often exceeded under natural conditions. Housing systems have the potential to impact production and welfare everywhere, but they should, in fact, minimize the negative effects of the natural environment on the animals.

In intensive meat production systems, growing rabbits are kept in wire net cages of variable dimensions equipped with a feeder and a nipple drinker. The wire net floor, although ideal for hygienic purposes, is considered unsuitable for animal welfare because it prevents the full expression of the behavioral repertoire (reviewed by Jordan *et al*., 2006). Cage enrichment on the other hand, has been proposed as a way to stimulate hiding, resting, exercising and decreasing the state of stress.

In the present study, the effects of temperature and cage floor enrichment on some behavior activities of growing rabbits from weeks 5 to 10 of age and the effect of temperature on cage floor choice were investigated.

MATERIALS AND METHODS

Forty-eight rabbits from the Botucatu genetic group (Moura *et al*., 2001), weaned at 35 days of age, were used in a five-week experiment from March 6 to April 10, 2006. They were housed at low density (1,500 cm^2), four per cage, in 12 wire net cages. These cages were randomly assigned to one of two chambers (3.5 x 3.0 x 2.5 m): a natural temperature chamber or a refrigerated one. The latter was equipped with an air conditioning unit (12,300 BTU/h), in order to maintain temperature within the rabbit thermoneutral zone. Natural temperature was presumably high because the experimental period coincided with late summer and the beginning of fall in the southern hemisphere.

In each chamber, three cages had half of the floor surface area covered with a wooden board enriched with litter straw, and the other three were not enriched. In order to maintain hygienic conditions, the straw was removed and replaced and the boards were cleaned every other day. Two bottles fitted with nipples and positioned at the right and left sides of the cages provided water. Similarly, two feeders located at the right and left sides of the cages provided a balanced and pelleted feed produced on Campus, according to the requirements described by De Blas and Mateos (1998). Therefore, in enriched cages rabbits had free choice between deep litter and wire net floors and in both, enriched and non-enriched cages rabbits had free access to water and feed on both sides of the cage.

Maximum and minimum temperatures as well as air relative humidity were registered daily at 09:00, 14:00 and 21:00 h during the experimental period. Average daily temperature and relative humidity were calculated according to the equations proposed by Muller (1989). In both chambers, fluorescent tubes were on from 07:00 to 19:00 h daily.

In enriched cages, the number of rabbits on the wire net floor and on the litter straw was registered by scan sampling, every five minutes, in five 24-hour observation periods, carried out once a week, over five weeks. Chi-square tests were used to compare the preference of rabbits between floor types.

The behavior of animals was also evaluated in five 24-hour observation periods, carried out once a week, over five weeks. Five different behavioral activities were considered: ludic, stereotypic, exploratory, self-grooming and social interaction. Jumping, running and hopping were considered ludic behavior activities. The exploratory behavior (or interaction with the environment) was recorded when an animal chewed the straw or smelled the air. Gnawing the bars of the cage was considered as stereotypic behavior. Self-grooming was represented by licking or scratching his own body and social interaction by allo-grooming or smelling a rabbit of the same cage. These behaviors were recorded at the time they occurred and were summed up for every two-hour period over the five 24-hour

observations. The number of events from each of the five behaviors was compared between enriched and non-enriched cages (within chambers) using chi-square tests.

RESULTS AND DISCUSSION

As expected, mean temperature and relative humidity were higher in the natural temperature chamber than in the refrigerated one (23.6ºC and 78.7% vs. 20.6°C and 71.0%, respectively). In general, rabbits were less active during the day from 08:00 to 18:00 h (Figure 1). Chamber temperature affected the proportion of rabbits on the wire net in enriched cages. In the natural temperature chamber, the proportion of rabbits on the wire net floor was much higher than on the litter straw (77.9 vs. 22.1%, $P<0.01$), whereas in the refrigerated chamber these proportions were similar (45.9 vs. 54.1%, $P=0.41$). This is in agreement with the findings of Bessei *et al*. (2001) reviewed by Verga *et al*. (2006) and is an indication that the use of litter straw may not be favorable under tropical conditions.

A total of 6,080 behavioral events were registered over the five 24-hour observation periods. Overall, self-grooming was the most frequent behavioral activity (51.9%), whereas stereotypes were the least frequent (5.2%); the other three behaviors (exploratory, ludic and social interaction) showed intermediate frequencies (20.6, 11.7 and 10.6%, respectively).

A higher number of ludic events were recorded in enriched cages of both chambers, especially at night, from 18:00 up to 08:00 h (Figures 1 and 2). A frequency pattern similar to the ludic behavior was found for the exploratory behavior, i.e. a higher incidence in enriched cages of both natural temperature and refrigerated chambers (Figures 1 and 2). Jointly, these results suggest that rabbits in enriched cages were more active, possibly reflecting a higher degree of welfare. Similarly, Verga *et al*. (2004) reported that rabbits in an enriched environment (wood stick) performed more exploration and less resting than those kept in barren cages.

Even though the incidence of stereotypies was clearly lower at the refrigerated chamber than in the natural temperature chamber (Figure 1), it was relatively higher in non-enriched cages of both chambers (Figure 2). Therefore, animals in non-enriched cages showed more pronounced signs of low adaptation to the environment and stress (Gunn and Morton, 1995; Hansen and Bethelsen, 2000). Self-grooming was also more frequent in non-enriched cages (Figure 2): in the natural temperature chamber, it showed an elevated prevalence at night, whereas in the refrigerated chamber, the difference occurred during the day (Figure 1). An elevated frequency of short sequence self-grooming in caged rabbits has been interpreted as an expression of stereotypy, indicating absence of environmental stimuli (Hansen and Bethelsen, 2000).

In the natural temperature chamber, social interaction was higher in non-enriched cages, whereas no differences between enriched and non-enriched cages were observed at the refrigerated chamber (Figures 1 and 2). These results contrast with those from Verga *et al*. (2004), who found that rabbits in enriched cages performed more allo-grooming and smelling another rabbit than those in non-enriched cages. Yet, those authors used higher housing densities than the ones in the present study and provided wood sticks instead of straw.

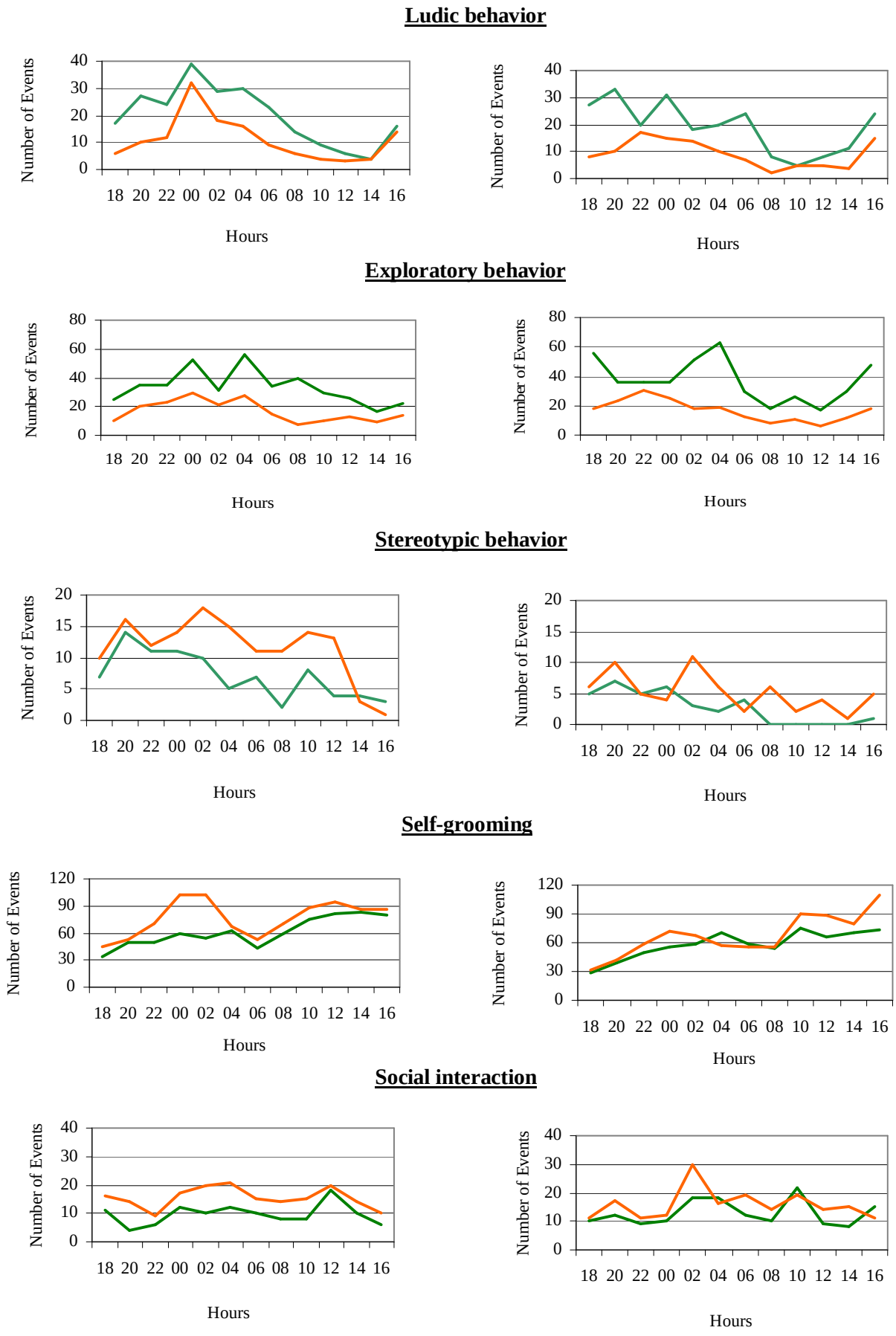

Figure 1: Incidence of behavioral activities in enriched (——) and non-enriched (——) cages at the natural temperature chamber (left panels) and at the refrigerated chamber (right panels)

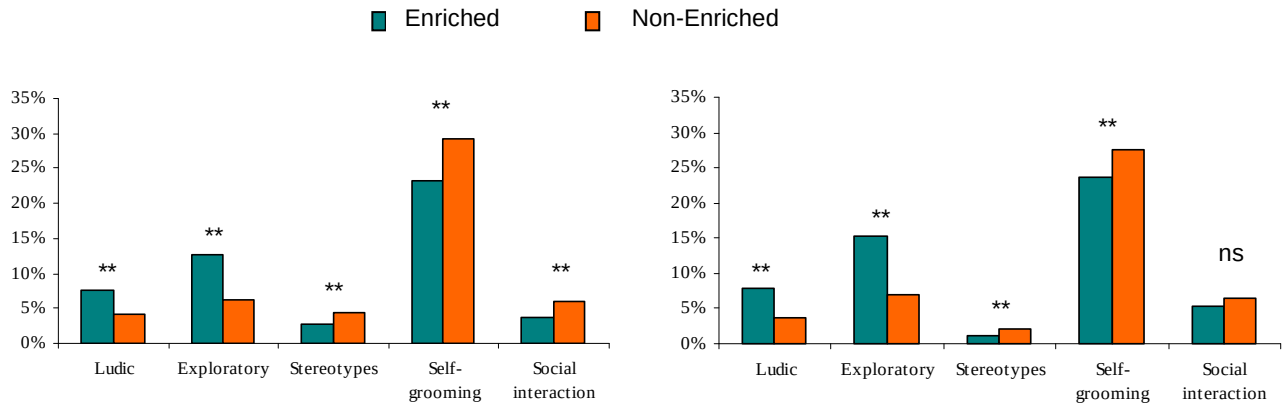

Figure 2: Proportions of behavioral events in enriched and non-enriched cages at the natural temperature (left panel) and refrigerated chambers (right panel)

CONCLUSIONS

Although environmental enrichment with straw has had a favorable impact on rabbit welfare, as evidenced by the pattern of behavioral activities, its positive effects were less intense when the temperature was higher. Furthermore, higher temperature substantially decreased the proportion of rabbits that chose to stay on the litter straw in enriched cages. Other ways to set the straw for cage enrichment or other types of enrichment should be investigated for use under tropical conditions.

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