EFFECT OF TEMPERATURE ON BREEDING RABBIT BEHAVIOUR

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ABSTRACT

The aim of the study was to assess activity, position and behaviour parameters as indicators of heat stress in rabbits subjected to a circadian heat stress cycle. Ten does (80-105 days old) and 6 bucks (180 days old) individually housed in commercial wire cages were observed during 12 days 12 hours a day by means of videocameras using scan sampling at 5 minutes interval. Rabbits were divided in two buildings. Five females and three males were housed at 18.4ºC mean temperature (control group) and the rest at 20.1ºC, 17 hours a day, and at 27.9 ºC the rest 7 hours (heat stress group). Position in relation to the corridor (watching it, avoiding it or perpendicular), activity (lying, sitting, prostrated or moving) and behaviour (grooming, exploring, resting, feeding and drinking) were assessed. Statistical analyses were performed with Genmod of SAS. No differences were found between treatments in feeding and drinking behaviour and animals moving. The presence of resting behaviour, watching the corridor and be prostrated was higher ($P<0.05$) in heat stress than control treatment and the contrary ($P<0.05$) was observed for lying, sitting and exploring. In the case of grooming, a clear compensation could be observed, rabbits reducing this activity in the heat stress period but increasing it just before and after this period in comparison to control animals. It is concluded that rabbits change their behaviour in moderate thermal stress, animals prostrated being a good indicator for the assessment of these conditions.

Key words: Activity, behaviour, heat, Oryctolagus cuniculus, rabbits, welfare

INTRODUCTION

According to Verga et al. (2007), the ideal environmental temperature range for rabbits should be 16-21ºC for does and 12-16ºC for bucks, with a relative humidity around 60%. Consequently, most of the rabbit farms need of refrigeration systems for the warmest months of the year. However, in some cases, it is not possible to achieve the thermoneutral zone and, consequently, they are subjected to thermal stress. Rabbits are very sensitive to high temperatures since they have few functional sweat glands limiting their ability in eliminating excess body heat. Thermal stress affects the animal in different ways, such as reducing the feed intake (Morrow-Tesch et al., 1994), increasing disease susceptibility (Kamwanja et al., 1994), or affecting reproductive efficiency (Marai and Rashwan, 2004). However, stress induced reactions in animals include behavioural modifications aiming at coping towards the stressor. Although these behavioural changes could be more difficult to perform when animals are housed in typical cages of rabbit production than in natural environments, the hypothesis of the present work is that the changes can be clearly identified in moderate heat stress conditions by observing activity, position and behaviour of does and bucks. Therefore, the aim of the study is to assess activity, position and behaviour parameters as indicators of heat stress in does and bucks subjected to a circadian heat stress cycle.

MATERIAL AND METHODS

The present study was carried out during 12 consecutive days between February and March 2010. Two identical closed buildings (46.5m^2) with ventilation and heating systems allocated in IRTA facilities in Torre Marimón (Caldes de Montbui, Barcelona, Spain) were used. In the moment of the experiment, a total of 55 commercial breeding hybrid rabbits (Caldes line) were being housed in each building (43 nulliparous does and 12 bucks). However, only 10 females (six 105 days old and four 80 days old) and 6 males (180 days old) were studied. When females were 60 days old they were located at the buildings and individually caged in wire cages with plastic footrests that covered part of the wire flooring. Female cages were equipped with a feeder, a nipple drinker and a nest box (100 length x 42 width x 38 height cm). At the age of 120 days, males were located at the same buildings and individually caged with plastic footrests. Cages (85 length x 40 width x 30 height cm) were equipped with a feeder and a nipple drinker. Animals were fed *ad libitum* with all-mash pellet and water was also available *ad libitum*. The photoperiod followed a 24 hours rhythm and included an uninterrupted dark period of 8h. Building A (control treatment) was maintained during the experiment at 18.4±1.55 ºC with 55.1±7.70 % relative humidity (RH) and Building B (heat stress treatment) was maintained from 16:00 h to 09:00 h at 20.1±0.98ºC with 52.2±6.26 % RH and from 09:00 h to 16:00 h at 27.9±2.70 ºC with 34.7±6.29% RH (Figure 1).

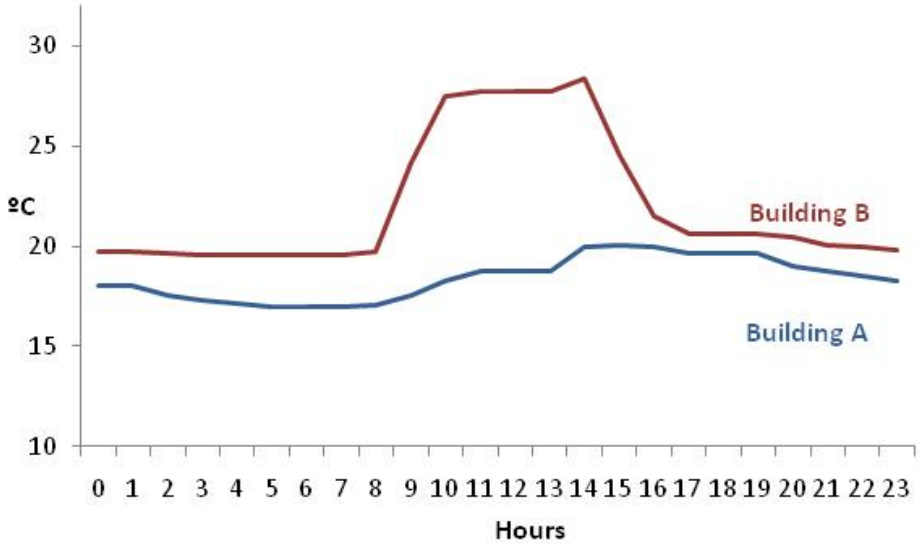

Figure 1. Temperature treatment applied to each building.

In each building, three cameras were installed (Ex-view Sony, Barcelona, Spain) and connected to a video recorder (Circontrol®, Terrassa, Spain) in both buildings. Camera 1 and 4 were used to observe 3 males in each building, cameras 2 and 5 to observe 3 females 105 days old in each building and cameras 3 and 6 to observe 2 females 80 days old in each building. Four periods of three hours were selected along each day: from 02:00 h to 05:00 h, 08:00 h to 11:00 h, 14:00 h to 17:00 h and 20:00 h to 23:00 h. These periods allowed to study the reaction of animals during the daily increase and decrease of temperature in the stress heat building and when it was maintained at similar temperatures in both buildings. In order to assess the behaviour of the ethogram (Table 1), the images were analysed by means of a scan sampling method (Altmann, 1974), at 5 minutes interval. If there was a doubt about the behaviour of the animal, the image was observed in movement during 5 seconds. Although panting, defined as rapid and shallow breathing, was included in the study, no animal was observed performing this behaviour.

Statistical analysis

Logistic regression, with logit link function, was used to analyse the folowing variables: position 1, position 2, position 3, lying, sitting, prostrated, moving, grooming, exploring, feeding, drinking and resting. GENMOD procedure of Statistical Analysis System (SAS 9.2; software SAS Institute Inc.

Table 1. Ethogram used for does and bucks, based on Shepers (2009) and Prinz *et al.*, (2008)

Parameter		Description
Position		
	Position 1	Animals with the head whatching the corridor
	Position 2	Animals with the head whatching opposite to the corridor
	Position 3	Animal in a perpendicular position in relation to the corridor
Activity		
	Lying	Animals lying down
	Sitting	Animals with the forelimbs not folded beneath the body but being straigh in a way that the thorax and abdomen were clear from the floor and visible
	Prostated	Lying in a stretched out position, ventrally, dorsally or laterally
	Moving	Displacement into the cage shaking or twisting of the body, flicking of the head and kicking at walls with hindfeet
Behaviour		
	Grooming	Self grooming or performing coprophagy
	Exploring	Chewing or licking anything that was not food, sniffing the environment, gnawing or marking with the chain
	Resting	Lying down or sitting down with the eyes open and responding to the environment, sitting up or sleeping
	Feeding	Consumption of feed from the feeder, gnawing the pellet
	Drinking	Drinking water from nipple drinkers

2002-2008) with binomial distribution was used. The mixed model included treatment (stress vs control), gender (male vs female) and the interaction treatment*gender as fixed effects and the permanent random animal effect. In all cases, the accepted significance level was fixed at $P < 0.05$.

RESULTS AND DISCUSSION

Position

From the 27 648 total observations, animals were found in position 1 in 26.5%, position 2 in 11.9% and position 3 in 61.6%. These percentages are shown by genders and treatments in Table 2. Position 1 was different between treatments at 09:00 h (P=0.0092) and 10:00 h (P=0.0072). No differences between treatments or genders were found for position 2. In relation to position 3, animals from the control treatment stayed longer in this position than animals from the stress treatment at 09:00 h (P = 0.0370).

Activity

From the 27 648 total observations, animals were found lying in a 38.2%, sitting in a 34.4%, prostrated in a 26.5% and moving in 0.9%. These percentages are shown by genders and treatments in Table 2. Animals from stress treatment spent less time lying than animals in the control treatment at 02:00 h (P = 0.0313), 03:00 h (P = 0.0321), 14:00 h (P = 0.0084) and 15:00 h (P = 0.0374). Animals from stress treatment stayed less time sitting than animals in the control treatment at 09.00h (P = 0.0079), 10:00 h (P = 0.0011) and 14:00 h (P = 0.0069), but the contrary was observed at 15:00 h (P = 0.0058). Animals from the stress treatment stayed longer in a prostrate posture at 03:00 h (P = 0.0407), 10:00 h (P = 0.0101) and 14:00 h (P = 0.0037) than animals from the control treatment. Finally, at 04:00 h (P = 0.0234) and 16:00 h (P = 0.0190) rabbits were moving for longer in stress treatment than in control one.

Behaviour

From the 27 648 total observations, animals were found resting in 54.2%, grooming in 18.5%, exploring in 17.6%, feeding in 8.5% and drinking in 1.2%. In Table 2 these percentages are shown by genders and treatments. Animals from stress treatment performed more time grooming than animals in the control treatment at 08:00 h (P = 0.0481) and 15:00 h (P = 0.0420). However, at 09:00 h (P = 0.0083), 10:00 h (P = 0.0029) and 14:00 h (P = 0.0051) animals from stress treatment performed

grooming less time than animals in the control treatment. Animals from control treatment performed exploratory behaviour for longer time at 09:00 h (P = 0.0218) and 10:00 h (P = 0.0179) than animals from stress treatment. Animals from the control building fed for longer than animals in the stress building at 09:00 h (P = 0.0097). No differences were found between treatments in time performing drinking behaviour. Resting behaviour was affected by treatment at 09:00 h (P = 0.0077), 10:00 h (P = 0.0028), 14:00 h (P = 0.0059) and 15:00 h (P = 0.0227), being higher in the stress treatment than in control treatment in the three firsts cases and lower in the last one.

Table 2. Mean ± SD of percentage of time spent in different positions (1, 2 or 3), activities (sitting, lying, prostrated or moving) and behaviours (grooming, exploring, feeding, drinking or resting) in does and bucks in stress and control treatments

	Females (%)		Males (%)	
	Stress treatment	Control treatment	Stress treatment	Control treatment
Position 1	28.5 ± 3.00	19.5 ± 4.58	29.8 ± 14.24	30.1 ± 6.82
Position 2	11.4 ± 3.32	12.3 ± 2.83	11.5 ± 2.20	13.4 ± 5.55
Position 3	60.0 ± 3.93	68.3 ± 3.26	58.8 ± 13.99	56.4 ± 7.35
Sitting	35.3 ± 15.42	34.3 ± 10.36	31.8 ± 15.36	33.3 ± 9.86
Lying	29.4 ± 10.68	42.7 ± 10.55	37.3 ± 12.96	46.1 ± 13.38
Postrated	34.3 ± 11.52	22.1 ± 4.58	29.9 ± 6.29	20.2 ± 4.88
Moving	1.0 ± 0.63	0.8 ± 0.54	1.0 ± 0.56	0.8 ± 0.48
Grooming	16.7 ±6.26	18.9 ± 3.32	17.8 ± 6.09	18.8 ± 4.91
Exploring	15.4 ± 4.38	18.4 ± 3.90	17.7 ± 5.73	19.3 ± 3.82
Feeding	7.1 ± 4.27	7.8 ± 4.07	9.7 ± 5.89	9.3 ± 3.85
Drinking	1.6 ± 1.20	1.5 ± 0.80	1.0 ± 0.78	1.0 ± 0.58
Resting	59.1 ± 15.28	53.4 ± 9.87	54.0 ± 15.78	51.6 ± 10.68

DISCUSSION

In the present study, prostration was very stable during the day in control rabbits, accounting for around 15-25% of the total time observed. However, in stress treatment, an important increase was observed in males and females at the warmest time of the day. In fact, the total time that rabbits spent in a prostrated posture was 45% and 54% higher in stress than control treatment in males and females, respectively, being these differences caused by the peak observed in the warmest hours.

Morisse et al. (1999) described that growing rabbits spent 19% of time grooming, similarly to the 18.5% found in the present study. Although grooming decreased in stressed treatment rabbits at 09:00 h, 10:00 h and 14:00 h (while the temperature was increasing until reaching the top), the total time dedicated to this behaviour along the day was very similar between treatments (see Table 2). This is caused by two reasons. Firstly, it was due to the previous behavioural increase observed at 15:00 h (while the temperature was decreasing), not observed in control animals. Secondly, it was due to the behavioural increase observed at 08.00h (before the onset of increasing temperatures) not observed in control animals. This suggests that when any behaviour is important for rabbits, such as grooming, they can try to compensate their absence (i.e. due to higher resting behaviour caused by heat stress) by increasing the normal activity in other cooler hours. In addition, the results also suggest that when a stable temperature cycle is established, animals can predict the moment in which temperatures will increase and they will increase some important activities, such as grooming (as it happens at 08:00 h),

that will not be performed later in warmer conditions. In contrast to grooming, animals subjected to heat stress treatment behaved less time exploring than animals in the control treatment, especially while the temperature was increasing (at 09:00 h and 10:00 h), but in contrast to grooming, no compensation of this behaviour was observed in other hours.

CONCLUSIONS

In the present study, some important behavioural changes were found in does and bucks exposed to moderate thermal stress in comparison to control ones, animals prostrated being a good indicator for the assessment of this stress in rabbits. However, in a constant circadian cycle, animals demonstrated the capacity to adapt their behaviour to these conditions, compensating some important behaviours, such as grooming, and decreasing others, such as exploring.

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