CIRCADIAN CHANGES OF RECTAL TEMPERATURE AND FEED AND WATER INTAKE IN ADULT RABBITS UNDER HEAT STRESS

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ABSTRACT

Forty six cross-breed New Zealand, California, Butterfly, Dutch and Satin rabbit does with an average weight of 3.67±0.37 kg (standard deviation) were divided randomly in two groups. The first one was shaved two days before the beginning of the trial and the second one remained unshaved. During 24 consecutive hours, rectal temperature (23 rabbit does/treatment), feed and water intake (10 rabbit does/treatment) were recorded every 4 hours. In the same period the farm temperature and the relative humidity were recorded. The farm was an open-air building in which temperature-humidity index (THI) was higher than 28.9 (severe heat stress) from 10:00 to 18:00 h, which fit very close with the sun light period. In this period rabbit does rectal temperature evolved in parallel to farm temperature/THI, and almost no eating or drinking activity was detected. The maximum farm temperature (or THI value) was reached around 14:00 h, that is the same time in which rabbits showed their highest rectal temperature (increased from 39.1 to 39.6ºC; $P<0.001$). From 18:00 h onwards farm temperature/THI and rectal temperature decreased and rabbit does begun their feed and water intake period. The lowest farm temperature/THI and rectal temperature were observed during night that is the natural period for rabbit eating. Shaved rabbit does showed a lower rectal temperature than no shaved animals (39.3 vs. 39.4ºC; $P=0.045$) and a higher feed intake (10.0 vs. 7.87 $g/kg^{0.75}$/4 h; $P=0.019$), especially at the beginning of the eating period ($P=0.043$). Water intake varied in parallel to feed intake and was not influenced by shaving (21.6 $ml/kg^{0.75}$/4h, on average). In conclusion, rabbit heat stress hours fit with the highest rectal temperature and the lowest feed and water intake. Further and more practical strategies must be investigated to decrease heat stress in our environmental conditions.

Key words: Rectal temperature, Feed intake, Water intake, Heat stress, Rabbit.

INTRODUCTION

The influence of hot ambient temperature on rabbit body temperature is well documented, and it is a limiting factor for rabbit performance in warm countries (Marai *et al*., 2002a). However, these studies have been carried out in rabbits submitted to temporal heat stress (i.e. during summer). In our conditions (Maracaibo, Venezuela), high temperature remains all the year, and it is combined with high relative humidity which can even impair the effect of high temperatures. Both environmental conditions (temperature and relative humidity) and digestive habits in rabbits (feed intake and faeces excretion. Prud'hon, 1973; Carabaño and Merino, 1996) follow circadian rhythms. Under heat stress conditions digestive circadian habits might be altered in order to adapt to the adverse environment. The aim of this work was to characterize the circadian rhythms of rabbits (rectal temperature, feed intake and water intake) and the capacity of rabbit does to eliminate heat under our heat stress conditions, by comparing shaved and not shaved animals.

MATERIALS AND METHODS

Forty six cross-breed New Zealand, California, Butterfly, Dutch and Satin rabbit does with an average weight of 3.67±0.37 kg (standard deviation) were divided randomly in two groups. The first one was shaved two days before the beginning of the trial and the second one remained unshaved. Shaved area extended from scapula to sacred zone with a 20 cm width. A bovine electrical shaving machine was used. A commercial pelleted diet containing (estimated, g/kg DM) 165 crude protein, 360 neutral detergent fibre and 45 acid detergent lignin, was offered *ad libitum*. During 24 consecutive hours, rectal temperature (23 rabbit does/treatment), feed and water intake (10 rabbit does/treatment) were recorded every 4 hours. Rectal temperature was measured by using a clinical thermometer inserted 2 cm into the rectum for 2 minutes. In the same period it was registered the farm temperature and the relative humidity. The experiment was conducted at Ana Maria Campos Experimental Farm facilities which climate condition is characterized as tropical very dry forest (Holdrige, 1978). The farm is an open-air building equipped with a ventilator to favour air recycling and a mesh (80% shade) in the windows to avoid animals were exposed to the sun. There were no artificial light. Animals were housed in flat-deck cages of 500 × 100 × 500 mm (0.5 m^2) equipped with one plastic bottle nipple drinker and one hopper feeder (30 cm available) each one. Water was filtered before stored in the farm. The temperature-humidity index (THI) was calculated according to Marai *et al*. (2001): THI = db°C – [(0.31 – 0.031 RH) × (db°C – 14.4)], where db°C is dry bulb temperature in Celsius degrees, and RH is the relative humidity as percentage. According to Marai *et al*. (2002b) there is severe heat stress when THI is higher than 28.9, and under 27.8 there is no heat stress. Results obtained from doe rabbits were analyzed by a repeated measures analysis using MIXED procedure of SAS (Littell *et al*., 1996). Model included treatment (shaved or not), time and its interaction. In the case of rectal temperature metabolic weight was included as a covariate. Variances and covariances matrix structure was modelized according to an auto-regressive structure (Littell *et al*., 1998). Statistical analysis was made using the Statistical Analysis System, SAS (version 8.2).

RESULTS AND DISCUSSION

In our farm it can be considered that rabbits are under heat stress from 08:00 to 19:00 h according to Marai *et al*. (2002b) (Figures 1 and 2), being exposed to very severe stressed from 10:00 to 18:00 h which fit very close with the sun light period and the increase of rectal temperature detected in rabbit does (Figure 3). In this period, rabbit does rectal temperature evolved in parallel to farm temperature/THI, and almost no eating or drinking activity was detected (Figures 4 and 5). It can be explained both to the adverse condition and that in this period they might be ingesting the soft faeces (Carabaño and Merino, 1996), activity that might be regulated by the time of sunrise and/or sunset (light on and off).

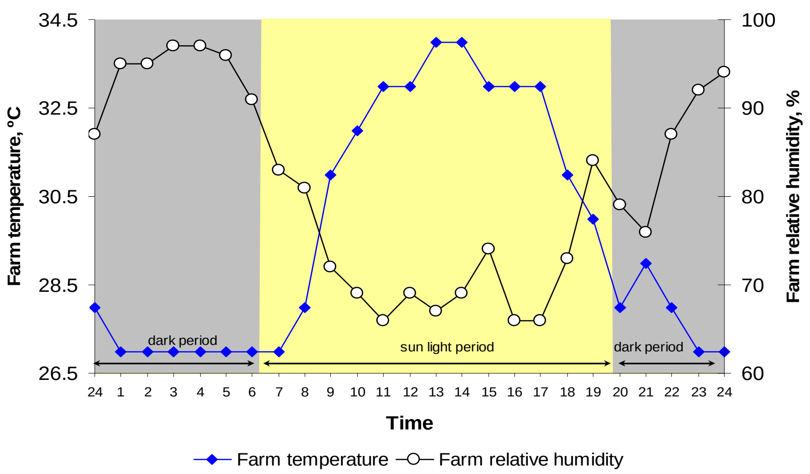

Figure 1: Circadian evolution of temperature and relative humidity inside the farm

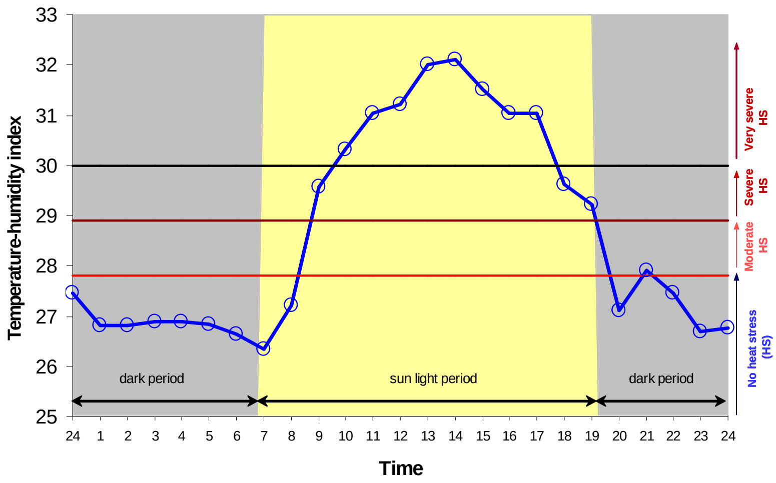

Figure 2: Circadian evolution of temperature-humidity index (THI) inside the farm calculated according to Marai *et al*. (2001)

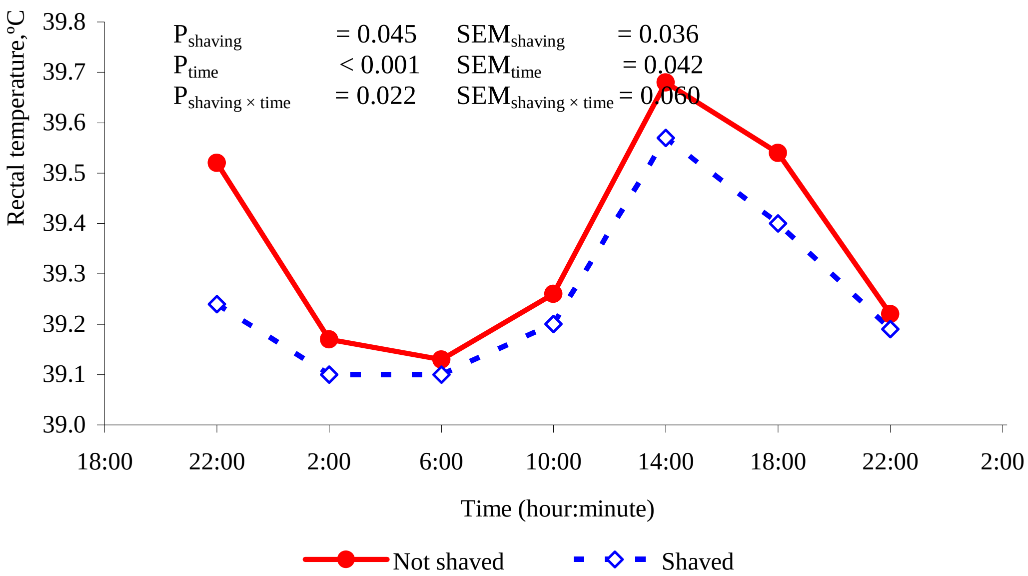

Figure 3: Circadian evolution of feed intake of shaved or not rabbit does (n=23/treatment). ($P_{metabolic\ weight}$ = 0.021)

The maximum farm temperature (or THI value) is reached around 14:00 h, that is the same time in which rabbits showed their highest rectal temperature. From 18:00 h onwards farm temperature/THI, and rectal temperature decreased and rabbit does begun their feed and water intake period. The lowest farm temperature/THI and rectal temperature were observed during night that is the natural period for rabbit eating. From this result it can be deduced that feed intake has a minor influence on rectal temperature compared to farm temperature/THI.

Shaved rabbit does showed a lower rectal temperature than no shaved animals (39.3 vs. 39.4ºC. P=0.045) and a higher feed intake (10.0 vs. 7.87 g/kg$^{0.75}$/4 h. P=0.019), especially at the beginning of the eating period (P=0.043). These results suggest that rabbit doe requires some help to eliminate the accumulated heat and to minimize heat stress as also observed by Finzi *et al*. (1992a). Water intake varied in parallel to feed intake and was not influenced by shaving (21.6 ml/kg$^{0.75}$/4 h, on average). The ratio water/feed intake in this study was 2.5 ml water/g feed. It is lower than that recorded in a climatic chamber by Finzi *et al*. (1992b) (3.5 and 8.3 ml/g at 26 and 32ºC, respectively).

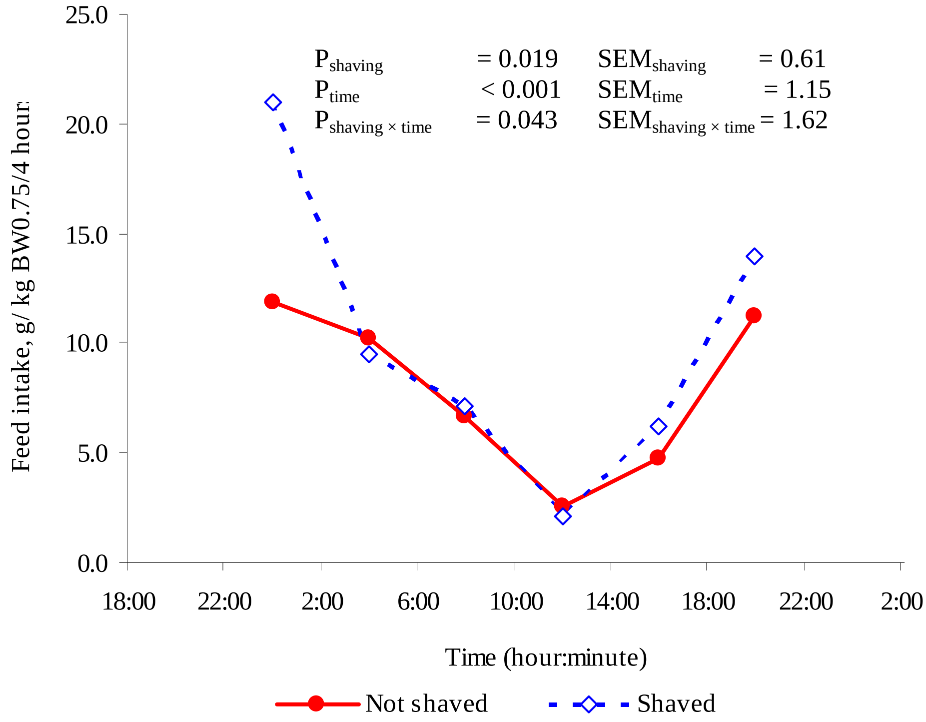

Figure 4: Circadian evolution of feed intake (g/kg $BW^{0.75}$/4 hours) of shaved or not rabbit does (n=10/treatment)

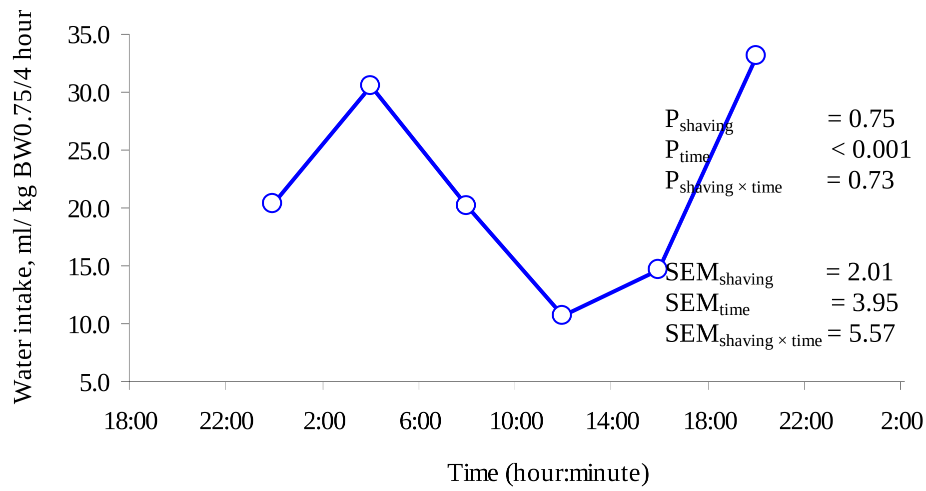

Figure 5: Circadian evolution of water intake (g/kg $BW^{0.75}$/4 hours) of shaved or not rabbit does (n=10/treatment)

CONCLUSIONS

Rabbit heat stress hours fit with the highest rectal temperature and the lowest feed and water intake. Further and more practical strategies must be investigated to decrease heat stress in our environmental conditions.

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