



## Heat stress in rabbits



IRTA



### Introduction

Adult rabbits are very sensitive to high temperatures, because of the lack of sweat glands and because of the thick fur which all prevent perspiration (evacuation of water through the skin) (Lebas, 1997). Above their thermal comfort zone (21°-25° C), rabbits exhibit several compensation behaviours to loss heat. These behaviours include **change of body position**, **increased breathing rate** and salivation, the latter supporting heat dissipation. When ambient temperatures exceed 35°C, rabbits can no longer regulate body temperature and are at significant risk of **hyperthermia** and **heat stroke** (Marai et al., 2002). An exception are new-born rabbits in their first 10-15 days of life, which their thermal comfort temperatures ranged between 30-35 °C, which are guaranteed by good nesting material. Different methods have been described to assess these physiological changes, which are described in the following paragraphs.



### Legal requirements

**Council directive 98/58/EC** concerning the protection of animals kept for farming purpose: "Air circulation, dust levels, temperature, relative air humidity and gas concentrations must be kept within limits which are not harmful to the animals." (Annex, Point 10)



### Animal-based indicators of heat stress

The animal-based indicators (ABI) used to assess heat stress in rabbits are panting (increased respiration rate), change in body position, red ears, and increased body temperature.

**Panting:** Proposed by De Jong et al. (2011) and used by Dalmau et al. (2020) to assess heat stress in rabbits. Rabbits show an increase of the respiratory frequency

to lose heat through evaporation of water (latent heat). Rabbits' breathing rate could increase rapidly reaching more than 200 respiratory acts per minute (basal rate is around 60) when the environmental temperature is higher than the thermal comfort zone (Marai et al., 2002; Jimoh and Ewuola 2016).

**Change of body position:** If the temperature is high (above 25 °C), the animals stretch out so they can lose as much heat as possible by radiation and convection and stretch ear pinnae and spread it far from the body to expose the surface to the surroundings to increase heat dissipation (Figure 1) (Marai and Rashwan, 2004). This indicator is visually assessed by EBENE protocol with other indicator of thermal discomfort (ITAVI, 2018).

**Red ears:** This indicator was proposed by de Jong et al. (2011) and listed in the EFSA report (2020) as a possible ABI to assess heat stress. The ear lobe plays an important role in thermoregulation of rabbits (Lebas, 1997). Indeed, the ear pinnae contain a complex and dense network of blood vessels and arteriovenous anastomoses that cool the blood through vasodilation (Morris and Bevan, 1984). This indicator is visually assessed by EBENE protocol with other indicator of thermal discomfort (ITAVI, 2018).

**Combined indicators of heat stress:** as mentioned previously, the EBENE protocol (ITAVI, 2018) combines all the indicators to assess signs of thermal discomfort. These signs are **fully stretched and panting animals, along with red, expanded ears (Figure 1)**.

**Indeed, use a combination of indicators of heat stress is recommended so that the assessor can have greater certainty that animals are suffering from high temperature. Moreover, the use of the Grimance Scale can aid the assessment of discomfort of the rabbits (Miller and Leach, 2023).**

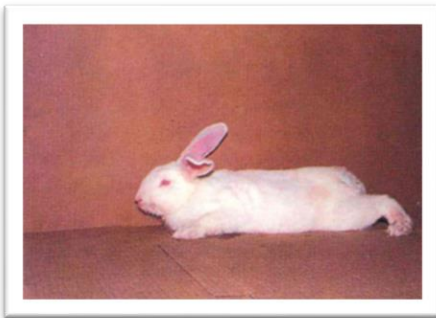
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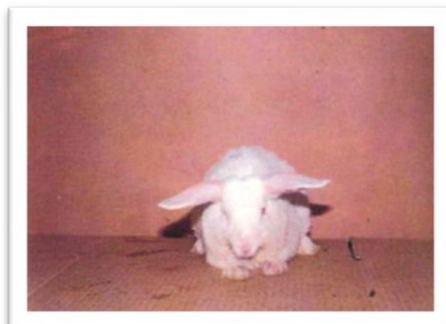
a



b



c



d



e

Figure 1. At 25°C the rabbit still has a normal attitude (**a**). At 30°C the rabbit begins to stretch its body to increase the passive dispersal surface. The ears appear reddened (vasomotor response) and begin to be carried sideways (**b**). At 35°C the animal, appears in pain (moderate orbital tightening and cheek fluttering) and prostrate with the body fully stretched, the muzzle and paws moist (increase in passive dispersion) due to licking (**c**). Typical lateral ear behaviour to avoid interference with body radiation (**d**). A group of subjects exposed to a temperature of 35°C (the orbital tightening is obviously present, sign of pain) (**e**). (Duranti et al., 1993).

**Increased body temperature:** This indicator could be used as a confirmation of heat stress. The normal body temperature of rabbit ranges from 38.5 to 39.5°C, and the individual difference ranges from 0.5 to 1.2°C (Liang et al., 2022). Clinical thermometers have been used to monitor body temperature (Jaén-Téllez et al., 2020). Rectal and ear temperature could be used to detect body temperature.

**Rectal temperature:** The rectal temperature of rabbits kept under thermal comfort zone ranges between 38.8 and 39.1 C, but may rise up to 41.6°C when exposed to elevated ambient temperature within 50 min (Jimoh and Ewuola, 2016).

**Ear Temperature:** can be measured by placing a digital thermometer in direct contact with the central area of the auricle. The ear temperature can range from 34 to 37°C when exposed to high THI values. However, differences between categories and breeds could be observed (Jimoh and Ewuola, 2016).

**However, these measurements can cause fear and stress, as contact must be maintained with the animals to take readings (Oladimeji et al., 2022).**

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**Infrared thermography (IRT):** IRT is a non-invasive method for measuring body temperature. This technique is particularly useful for identifying temperature changes across different parts of the body (Kunc and Knizkova, 2012). According to Jaén-Téllez et al. (2020), the best areas for measuring body temperature in rabbits using IRT are the **ears** and **eyes**. In summer, rabbits had outer ear temperatures ranging

from about 29.1°C to 32.2°C and eye temperatures from about 37.8°C to 38.1°C, depending on whether they were undisturbed or handled. In winter, outer ear temperatures ranged from about 16.2°C to 18.3°C and eye temperatures from about 36.9°C to 37.3°C, again depending on handling. More knowledge is needed to propose a T range when using IRT for assessing heat stress.



**The animal-based indicators of heat stress should be always verified also with the environmental temperature and humidity at the time of inspection.**



### Management and Resource based indicators

One of the most important climatic components that influences the welfare of farmed animals is the effective environmental temperature, that is the temperature that animals really feel (Turner et al., 2017). The following factors influence the effective environmental temperature, with the first two being the most important, as the feeling of heat stress in a hot environment increases with high relative humidity (Marai et al., 2002):

- **Environmental temperature**
- **Relative humidity**
- **Ventilation**
- **Flooring**
- **Cage/pen type**
- **Bedding**
- **Single or group housing**
- **Animal's stage of production**
- **Health status**

Useful tools for managing temperature and humidity on farm are described below.

### Temperature and humidity Index

The relative humidity Index (THI) is a valid tool to measure the severity of heat stress (Figure 2).

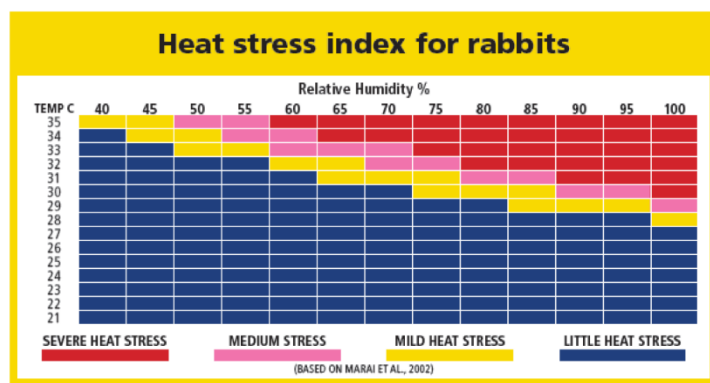


Figure 2: Heat stress Index for rabbits (Source: Turner et al. 2017).

A 'Temperature-humidity index' (THI) was proposed for rabbits by Marai et al. (2001;2002):

$$\text{THI} = \text{dboc} - [(0.31 - 0.31 \text{ RH}) (\text{dboc} - 14.4)]$$

where **dboc** = dry bulb temperature in degrees Celsius and **RH** = relative humidity in %.

THI value below 27.8 indicates absence of heat stress, while **over 28.9 represents severe heat stress**. THI is extensively employed in hot and humid places worldwide to evaluate heat stress on rabbits (Oseni and Lukefahr 2014).

### Temperature and humidity sensors on farm and ventilation systems

The careful control of airflow, environmental temperature and relative humidity, due to their close interrelationship, can significantly improve the health and welfare of rabbits (Turner et al., 2017).

Temperature and humidity can be automatically controlled by the means of thermo-hygrometer and probes placed at various points of the farm, which adjusts the ventilation and heating systems to fall within the recommended ranges (Table 1). This is highly recommended and is considered good management practice. Modern systems include control panel units that allow farmers to easily check the environmental parameters and their corresponding log history (Figure 3).



Figure 3: Temperature, humidity and gas monitoring control panel of the barn

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Table 1. Optimal microclimatic values for rabbits (Duranti et al., 1993)

Temperature (C°)	Humidity (%)	Air speed (m/sec)	Ventilation requirements (m <sup>3</sup> /kg l.w./h)
<b>12-15</b>	60-65	0.10-0.15	0.5-1
<b>16-18</b>	70-75	0.15-0.20	From 1 to 2
<b>19-22</b>	75-80	0.20-0.30	From 2 to 3
<b>22</b>	80-85	0.30-0.40	From 3 to 4

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Co-funded by  
the European Union



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