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Comparison infrared thermography of Balkan donkeys

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Abstract: Infrared thermography is an increasingly popular diagnostic method in equine veterinary medicine, while its application in donkeys remains relatively limited. The aim of this study was to determine the surface body temperature of six clinically healthy female donkeys of the breed Balkan donkey. The donkeys` bodies were divided into the following regions: neck, shoulder, thoracic limb, back, thigh and pelvic limb and were laterally scanned on both the left and right sides. Only the abdomens of the donkeys were scanned individually from the ventral side of the body. The mean surface temperature of each region was calculated revealing approximately bilateral thermal symmetry in the donkeys‘ bodies. Similar studies may be useful for donkey health and welfare given the renewed interest in donkeys as milking and companion animals.

Keywords: Balkan donkey; infrared thermography; body surface temperature; welfare

INTRODUCTION

The term Balkan donkey (*Equus asinus*) describes a group of related breeds originating in the Balkan Peninsula (Mijatović et al., 2022). Populations are heterogeneous and highly genetically diverse (Stanisic et al., 2017). Donkeys have been known for their valuable milk for thousands of years (Kaskous & Pfaffl, 2022). Donkey milk is remarkably similar to human milk, has been used in traditional diets and medicines since ancient times, and has become increasingly popular in recent years (Baloš et al., 2023; Šarić et al., 2023). There is no reliable statistical data on the share of donkey milk. However, it is assumed less than 0.1% of global milk production together with equine milk (Faye & Konuspayeva, 2012).

Infrared thermography detects and measures the infrared radiation spontaneously emitted by any object at a temperature above absolute zero (Soroko-Dubrovina & Morel, 2023). A painless, non-invasive method can be used to improve the physiological assessment and health (Turner, 1991). Thermography is readily available, inexpensive, and requires no special preparation, blood tests, premedication, anesthesia, or resuscitation (Redaelli et al., 2014). This method has been proven reliable in horse breeding, equestrian sport and equine veterinary practice worldwide. Thermography can provide valuable information on the welfare of other equids, such as pack mules (Lagos et al., 2023). However, the use of infrared thermography in donkeys is currently quite limited. One study compared the surface body temperatures between horses and donkeys (Domino et al., 2020). Another study is dedicated to the effects of seasons and age on the daily rhythmicity of rectal and body surface temperatures in a tropical savannah (Zakari et al., 2018). By measuring body surface temperature, specific thermal patterns can be created to assess the donkey’s overall health and welfare.

MATERIALS AND METHODS

The study was carried out on six female Balkan donkeys, aged between 6 and 11 years and weighing approximately 150-200 kg. Rectal temperature, pulse, and respiratory rate were all normal. Body surface temperature was measured using an infrared camera Thermovision XP (Laserliner, Germany). The thermal camera was set to an emissivity of 0.98. Thermographic measurements were performed at an ambient temperature of 22°C.

The donkeys` bodies were divided into the following regions: neck, shoulder, thoracic limb, back, thigh and pelvic limb and were laterally scanned on both the left and right sides. The imaging distance was approximately six meters for the whole body and one meter for the distal parts of the legs. The abdominal region of the donkeys was scanned individually in ventral projection. The infrared radiation was presented as a thermogram, where the color gradient corresponds to the distribution of surface temperatures. The software used for assessing the results was Quick Reporting-Editor.

Data analysis and statistical processing were performed using the SPSS 19.0 computer program. The average statistical values of body surface temperature were calculated at three points for each scanned region on the left and right sides of the six donkeys. Data are expressed as mean plus standard error. In this study, the assessment is made with a guaranteed probability of 0.95 (significance level $\alpha = 0.05$), where $p < 0.05$ was adopted as the lowest level of statistical reliability.

RESULTS

The average thermographic parameters showed approximate bilateral symmetry of the body surface temperatures of the donkeys (Table 1).

On the left side of the donkeys' bodies, the highest mean body surface temperatures were measured at the neck (30, 20 ± 0.585 °C), followed by the shoulder region (29, 64 ± 0.401 °C). An approximate decrease of 1,5-2°C was observed in the mean temperatures in the other measured left side regions: back (27,74 ± 0,359°C), thigh

Table 1. Mean parameters (°C) of body surface temperatures in six Balkan donkeys

anatomic region	side	Mean	Std. Error Mean	Minimum	Maximum	Variance
neck	left	30,20	0,585	25,60	33,90	6,178
	right	29,91	0,587	25,70	33,90	6,201
shoulder	left	29,64	0,401	27,10	32,90	2,901
	right	29,36	0,396	27,30	32,40	2,823
thoracic limb	left	27,83	0,628	23,80	33,90	7,094
	right	27,21	0,556	23,60	31,80	5,566
back	left	27,74	0,359	25,30	31,60	2,324
	right	27,46	0,390	24,90	31,30	2,743
thigh	left	27,60	0,415	25,10	31,20	3,106
	right	27,61	0,403	24,70	31,30	2,930
pelvic limb	left	28,07	0,661	24,20	33,20	7,883
	right	27,96	0,654	23,60	33,20	7,701
abdomen	ventral	25,45	0,242	23,60	27,10	1,054
$p \geq 0,05$						

(27,60 ±0,415°C), and in the distal parts of the limbs: thoracic (27, 83 ± 0,628°C) and pelvic (28,07±0,661°C) (Figure 1).

The highest mean body surface temperatures on the right side, similar to the left side, were also found at the neck (29.91 ± 0.587°C) and shoulder (29.36 ± 0.396°C). The lower mean temperatures measured on the back (27.46±0.390°C) and thigh (27.61±0.403°C) were approximately equal to the values of the distal parts of the forelimb (27.21±0.556°C) and hind limb (27.96±0.654°C) on the right side (Figure 2).

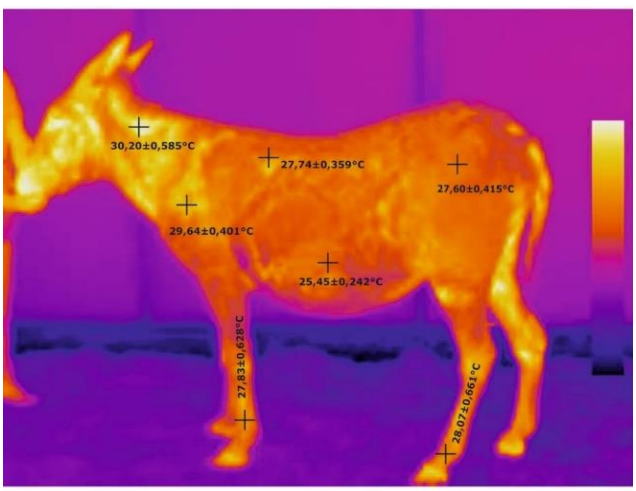

Figure 1. Average body surface temperature distribution on the left side of Balkan donkeys

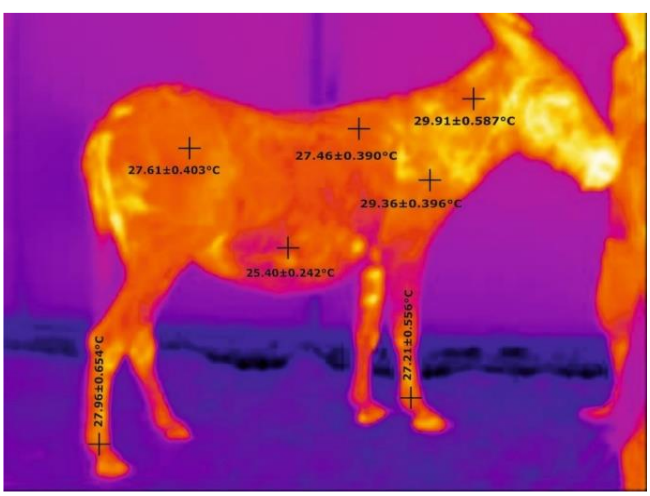

Figure 2. Average body surface temperature distribution on the right side of Balkan donkeys

The mean abdominal surface temperature (25.40±0.242°C) was the lowest compared to the other regions measured in the donkeys (Figures 1 and 2).

DISCUSSION

This study aimed to evaluate the use of infrared thermography in donkeys as a potential alternative screening diagnostic method for more accurately assessing health status and welfare.

As with other similar studies in equids, the highest mean body surface temperatures were measured in areas with large blood vessels, compared to areas with poor blood supply (Redaelli et al., 2014; Čebulj-Kadunc et al., 2020).

The highest mean values on the neck and shoulders were characterized by higher metabolic and vascular activity, suggesting a higher body surface temperature (Soroko-Dubrovina & Morel, 2023). These regions also have massive skeletal muscles and higher surface temperatures than less muscular regions (Jodkowska & Dudek, 2000; Redaelli et al., 2014). Some donkeys often develop a fat crest on the neck, which tends to hang to one side and is indicative of donkey fattening (Raspa et al., 2019). According to Domino et al. (2020), thicker skin and subcutaneous fat in donkeys provide better insulation and lower body surface temperatures than in horses.

The donkey fat neck phenomenon was not observed in our study. However, even the smaller deposit of fat under the neck and shoulders of a donkey's skin, can increase the body's surface temperature by absorbing heat from the surrounding blood vessels (Čebulj-Kadunc et al., 2020).

Lower body surface temperatures in the other thermographic regions, such as the back, distal limbs, and especially the abdomen probably due to poor blood supply, or because some of the donkeys had more hair during thermographic tests. Body surface temperatures in donkeys may be related to different thermal properties of the skin and hair coat (Domino et al., 2020).

Donkeys can also differ from each other, particularly in terms of anatomical and physiological conformation, and this can be considered a key criterion for their welfare (Valle et al., 2017).

CONCLUSION

The average surface temperatures of the donkeys showed approximately bilateral thermal symmetry, consistent with the normal trends observed in similar thermographic measurements in equids. Our study is one of the few to date describing the use of infrared thermography to measure surface body temperature in donkeys. We hope that in the future, infrared thermography will be useful in assessing the health and welfare of donkeys, given the renewed interest in these remarkable animals for breeding and milk production.

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