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S Ganesh Kumar
Assistant Professor, Livestock Farm Complex, VCRI, Tirunelveli, Tamil Nadu, India

N Kumaravelu
Dean, College of Food and Dairy Technology, Koduvalli, Chennai, Tamil Nadu, India

Thanga Thamil Vanan
Professor and Head, Department of Livestock Production Management, MVC, Chennai, Tamil Nadu, India

TR Pugazhenthi
Professor, Department of Livestock Products Technology, MVC, Chennai, Tamil Nadu, India

T Ravimurugan
Professor and Head, Dean's Office, VCRI, Tirunelveli, Tamil Nadu, India

Chhavi Gupta
Assistant Professor, Department of Veterinary Gynaecology and Obstetrics, VCRI, Tirunelveli, Tamil Nadu, India

Corresponding Author:
S Ganesh Kumar
Assistant Professor, Livestock Farm Complex, VCRI, Tirunelveli, Tamil Nadu, India

Effect on physiological response with heat exposure and work load cycle donkeys of Southern agro-climatic zone

S Ganesh Kumar, N Kumaravelu, Thanga Thamil Vanan, TR Pugazhenthi, T Ravimurugan and Chhavi Gupta

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Abstract
This study was performed in thirty (15 no. of male and 15 no. of females) White and Grey Donkeys at Southern agro-climatic zone. The mean (±SE) temperature (°C) and respiration rate (Respiration/min) pre heat exposure and post heat by exposure to heat at 11 am (Ambient Temperature 34.6°C and Relative humidity 48%) to 2 pm (Ambient Temperature 38.1°C and Relative humidity 41%) was recorded, along with Benezera coefficient of adaptability based on the rectal temperature and respiration rate responses after exposure of animals for 7 hours continuously for 3 days was assessed. Further, Grey donkeys were subjected to intermittent and continuous work-load cycle with 50 per cent of body weight. Heat tolerance test revealed no significant increase in the rectal temperature in male and female White and Grey donkeys. However, post heat exposure increased respiration rate was observed in Male Grey donkeys. Similarly, Benezera coefficient of Adaptability was significantly increased in male Grey donkeys. The mean body temperature (°C), respiration and pulse rate was increased significantly (p<0.05) after 1 h of work followed by a reduction after 30 min of rest in White and Grey donkey. The mean physiological parameters were increased significantly (p<0.05) after 2.5 h of work followed by a significant reduction (p<0.05) after 30 min of rest in Gery donkey. This study concluded the adaptability of White and Grey donkeys in southern districts of Tamil Nadu along with the comparative effect of different work load cycles on physiological parameters in Grey donkeys.

Keywords: Physiological parameters, white, grey donkey, pack loads, work cycle, southern agro-climatic zone

Introduction
Donkey is known as beast of burden throughout the world. They are sure footed, docile and hard-working animals. Donkeys have very good draught power, heat tolerance and stress bearing capabilities. The donkey is multifaceted utility animal that serves draught carrying pack at brick kiln, construction sites and by was herdman, potter man, small and marginal farmers (Pritchard *et al.*, 2006) [1].

In Tamil Nadu donkey rearing is a traditional occupation by certain communities. Inspite of the utility of the donkeys, the species remains neglected by the farmers, scientific community and policy makers. Moreover, lack of knowledge and awareness among donkey owners regarding recognizing stress, pain, and fatigue signs combined with excessive greed for earning profits by overloading at the brick kilns and sand often leads to the development of multiple health problems (Pritchard *et al.*, 2005) [2].

To avoid cruelty to donkeys and obtain optimum work output, they require being loaded optimally for an optimum duration along with local awareness and benefits of optimum workload have to be established in the donkey rearing management. Only a few experimental studies (Pal *et al.*, 2000; Pal *et al.*, 2012; Olaifa *et al.*, 2012; Legha *et al.*, 2018) [5, 4, 3, 6] are available with regard to work under pack load.

Further, heat tolerance is expected to be one of important adaptability aspect for working livestock which estimates the ability of livestock to adapt environmental conditions, as well as climatic extremes (Zakari *et al.*, 2018) [7].

Moreover, Zakari *et al.* (2018) [7] also stated that there are several physiology measure of heat tolerance, some of them are respiratory rate and rectal temperature based on Rhoad and Benezra's formula that had been with measuring the respiratory rate and body temperature of cattle between in the morning and at noon.

Hence, by assessing the effect on physiological response with heat exposure and work load cycle in White and Grey donkeys of Southern agro-climatic zone help to optimize the work load and to tailored the donkey welfare policies.

Materials and Methods

Location of study

The study was conducted at the villages of Tirunelveli (8.7139°N, 77.7567°E) and Thoothukudi (8.7642°N, 78.1348°E) districts and Veterinary College and Research Institute, Tirunelveli (8.7288°N, 77.7061°E) of Tamil Nadu, India during the period from January 2022 to August 2023.

Ethical procedures followed

In the present study, ethics on the endeavour to reduce animal suffering and adherence to best practices in veterinary care has been followed as per the permission accorded to the 50th Institutional Animal Ethics Committee, Tamil Nadu Veterinary and Animal Sciences University with approval No 01/LA/IAEC/2022.

Animal management and feeding module

Grey and White donkeys were reared in an extensive system of farming. They were fed with wheat bran, *ad-lib* roughage and grazed in the open terrains along with free access to drinking water except during the working period.

Experimental design

Heat tolerance test

This experiment was conducted during summer season where 30 donkeys (fifteen male and fifteen female) each Grey and White were exposed to direct sun from 8:00 am and 3:00 pm in the evening (Plate 1). The mean maximum and minimum temperature and relative humidity during the experiment were recorded for 3 days. Heat tolerance was measured using Benezra's Coefficient of adaptability.

BCA = RT/38.33 + RR/23

Interpretation: A calculated value of 2 shows maximum adaptability and values over 2 indicate a state of lower adaptability.

Duration of work rest cycle

Thirty indigenous Grey Donkeys of 7-10 years of age weighing 90 kg were used for carrying pack load (sand from river bank) equivalent to 50% of their live body weight for a maximum of 6hrs or until the onset of fatigue, whichever was earlier. The mean alteration in Rectal Temperature (RT) and respiration rate (RR) was estimated.Duration of work rest cycle in thirty Grey donkeys were used by 2 methods one was continuous work for 2.5 hours and the other was 1 hour work-30 minutes rest-1 hour work (Plate 2). The donkeys were walked for 10km at @1.5 km/hr on Kachcha road in morning hours with ambient temperature ranging from 26-36°C. Intermittent rest was given at every 500 meters distance during which the unloading and loading were done.

Results and Discussion

Heat tolerance test: The temperature (°C) and respiration rate (Respiration/min) pre heat exposure and post heat by exposure to heat at 11 am (Ambient Temperature 34.6°C and Relative humidity 48%) to 2 pm (Ambient Temperature 38.1°C and Relative humidity 41%) is presented in Figure 1.

In the present study, the pre-exposure and post-exposure mean body temperature did not differ significantly in male and female of white and grey donkey within and between the groups in the Southern agro-climatic zone. However, the pre-exposure respiration rate in male white donkey was significantly higher ($p<0.05$) and no significant difference was observed in respiration rate of female white donkey and male and female grey donkey. The post-exposure respiration rate in male white donkey was significantly higher ($p<0.05$) and no significant difference was observed in respiration rate of female white donkey and male and female grey donkey. Interpretation of Benezera coefficient of adaptability, for heat tolerance shows (Table 1) that White male donkey has maximum adaptability followed by female White, male and female Grey donkey, respectively. These findings were in agreement with Ayo *et al.* (2008) [8] who observed that in Nigeria, during hot-dry season donkeys were physiologically stressed, with the most thermally challenging period falling between 11 am and 4 pm. Further, Zakari *et al.* (2018) [7] suggested that increasing respiration rate and sweating might be hypothesized as the main mechanisms used by donkeys to release heat on exposure to high temperatures; therefore, increased respiration rate has been suggested as a good indicator of heat stress in donkeys.

Duration of work-rest cycle

In present study during intermittent work load cycle the mean body temperature (°C), pulse rate (min^{-1}) and respiration rate (min^{-1}) before work was 37.16±0.12, 36.42±0.71 and 21.45± 0.34, respectively which increased significantly ($p<0.05$) after 1 h of work as 38.50±0.65, 52.75±1.02 and 38.22±0.41 followed by a reduction after 30 min of rest as 37.78±0.25, 39.12±0.72 and 22.50±0.94, respectively. However, body temperature (°C), pulse rate (min^{-1}) and respiration rate (min^{-1}) increased significantly ($p<0.01$) as 37.54±049, 55.82±1.11 and 38.24±1.03, respectively after 1 h of work and which were reduced after 30 min of rest as 37.54±0.49, 40.01±1.65 and 25.39±0.85, respectively in grey donkey (Figure 2).

This study revealed that in continuous work load cycle the mean body temperature (°C), pulse rate (min^{-1}) and respiration rate (min^{-1}) before work was 36.06±0.18, 33.51±0.22 and 20.45±0.39 which were increased significantly ($p<0.05$) after 2.5 h of work as 38.27±0.54, 33.51±0.22 and 41.32±1.72 followed by significant reduction ($p<0.05$) after 30 min of rest in grey donkey as 37.64±0.27, 40.28±1.22 and 25.48±0.56, respectively in southern agro-climatic zone (Figure 3). The above findings were in agreement with Pal *et al.* (2012) [4] who reported that the increase in physiological parameters with fatigue score of 6 and 4 out of 16 under continuous and work-rest work cycle, respectively, with 40% of body weight as pack load while the fatigue score of 10 and 2 was observed under continuous and work-rest-work cycles, respectively, for 50% of body weight as pack load. Similar results were also obtained by Ram *et al.* (2012) [4], who reported that the values of Respiration Rate and Pulse Rate were significantly higher from light to moderate, light to heavy, and moderate to heavy work, which may be due to the effect of workload. This alteration in physiological values in the present study might be due to intermittent rest between work periods, which reduced the stress on these animals and resulted in increased work periods.

Conclusion

This study documented the adaptability of White and Grey donkeys in southern districts of Tamil Nadu. Further, with the comparative effect of different work load cycles on physiological parameters in grey donkeys suggested the promising working capacity and regional adaptability in southern agro-climatic zone.

Table 1: Mean ±SE Benezera coefficient of adaptability

	Pre exposure (N=30)			Post exposure (N=30)		
	Male	**Female**	**T value**	**Male**	**Female**	**T value**
White donkey	1.92±0.02	1.91±0.03	0.69^{NS}	1.99±0.04	2.00±0.05	0.68^{NS}
Grey donkey	1.99±0.01	1.95±0.04	0.31^{NS}	2.02±0.03	2.07±0.04	0.84^{NS}
T value	0.84^{NS}	0.97^{NS}		2.01^{*}	0.22^{NS}	

$^{**}p<0.01$; $^{*}p<0.05$; NS: Not Significant

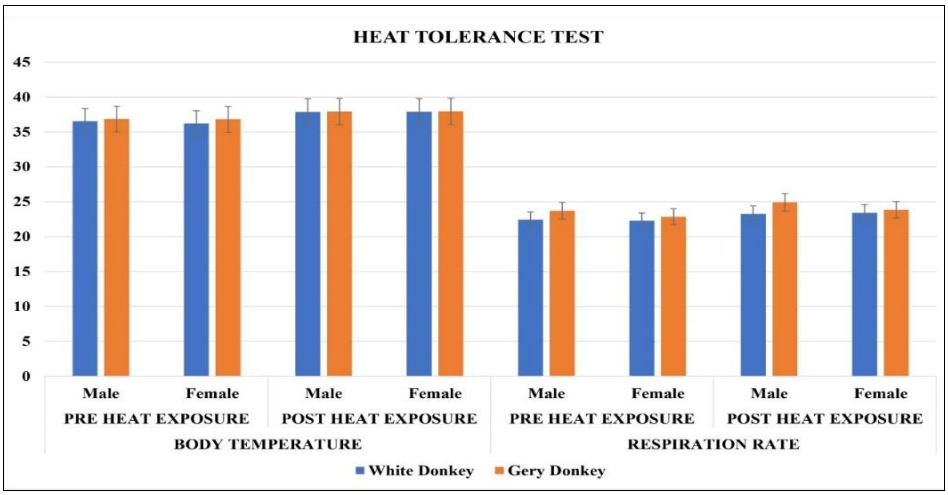

Fig 1: Mean (±SE) body temperature (°C), pulse rate (min^{-1}) and respiration rate (min^{-1}) pre and post exposure in white and grey in Southern agro-climatic Zone

Plate 1: Heat tolerance test Exposure to sun in Grey Donkey at Thoothukudi District

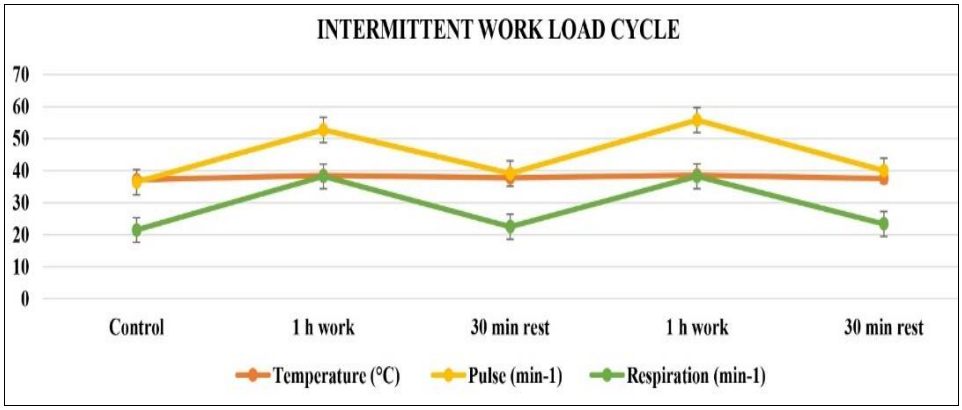

Fig 2: Mean (±SE) body temperature (°C), pulse rate (min^{-1}) and respiration rate (min^{-1}) to intermittent work-load cycle with 50% of body weight in Grey in Southern agro-climatic Zone

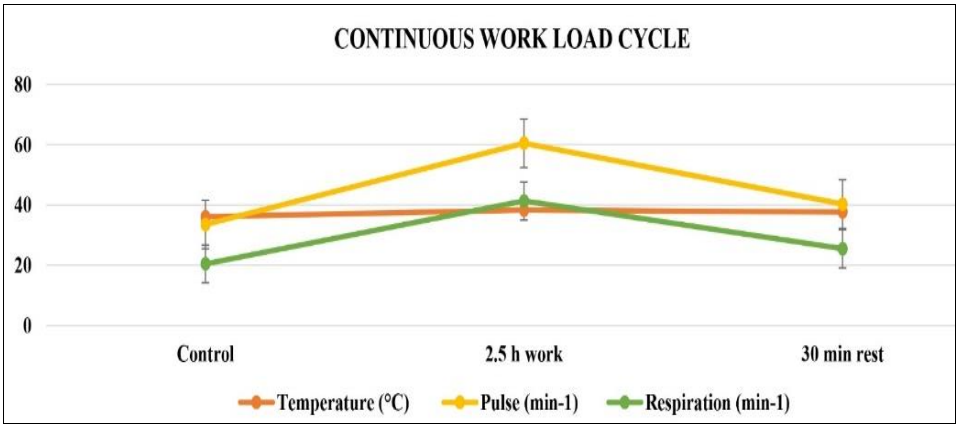

Fig 3: Mean (±SE) body temperature (°C), pulse rate (min^{-1}) and respiration rate (min^{-1}) to continuous work-load cycle with 50% of body weight in Grey in Southern agro-climatic Zone

Plate 2: Donkeys carrying load to estimate work rest cycle with 50% at Tirunelveli district in grey donkey in southern agro-climatic zone

Conflict of Interest: Not available

Financial Support: Not available

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