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Heat Tolerance in Donkeys and Mules

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Abstract: Heat tolerance in adult indigenous donkeys, exotic donkeys (Poitu) and mules was studied for exposure to direct sun during hot dry period. There were no inherent differences in the rectal temperature and respiratory frequency under shade in the three breeds. Eight hours of exposure daily for six consecutive days caused a significant ($P<0.05$) increase in the rectal temperature in exotic and indigenous donkeys, while respiratory frequency increased significantly ($P<0.01$) only in exotic donkeys. Further, in all the three groups, RR and RT values observed in the morning during and before the heat exposure period were very much similar. It suggests that all the equids in three groups were equipped with good thermolytic efficiency. Compared to the local donkeys and mules, the exotic donkeys were least heat-tolerant on exposure to direct sun, as judged from the higher increase in RT and RR, related possibly to the black/dark brown color of their hair that absorbs more incidental solar radiation.

Key words: Heat tolerance, donkey, mule, equine.

Equids, mainly donkeys and mules, are being used as draught and pack animals in India for different purposes, including transport of earthen pots, household goods, bricks, vegetables, other edibles, military ammunition, etc. Although these animals adapt to a wide range of agroclimatic conditions, their population is mainly concentrated in north-western states of the country. The animals have to work under very hard and odd conditions, including nutritional, environmental and work stress, without appropriate management. All these stresses have different effects on different breeds and species of equines (Gupta *et al.*, 1999; Pal *et al.*, 1998).

In Rajasthan, heat stress is one of the important factors affecting the working capacity of all the animals, including equines. Heat stress is known to affect the physiological indices in animals, including goats, lamb and equines (Singh and Saxena, 1995; Karim and Patnayak, 1999; Yousef, 1990). An attempt was made to study and compare the physiological adjustments made by indigenous and exotic donkeys and mules. The exotic donkeys (Poitu) were received as gift under Indo-UK collaborative research project through Overseas Development Authority (ODA, UK) at this centre for breed improvement and better quality mule production.

Materials and Methods

Twelve adult equids, consisting of 5 local non-descript grey colored donkeys (GI), 3 exotic black colored Poitu donkeys (GII) and 4 local non-descript chestnut colored mules (GIII) were used as experimental animals. All the animals were maintained in fully ventilated sheds having stone roof with natural (kuchcha) floor. All the animals were fed equal quantity

Table 1. Changes in rectal temperature and respiration rate in different species/breeds of equines during pre-exposure, heat-exposure and post-exposure period

Type of equids	Pre-exposure		Heat-exposure		Post-exposure	
	M	N	M	N	M	N
Rectal temperature (°C)						
Local donkey (GI)	36.55±0.06	37.06*a±0.05	36.71±0.11	37.39*a±0.05	36.08±0.24	37.34*±0.11
Exotic donkey (GII)	36.71±0.07	37.61*a±0.10	36.81±0.31	38.35*a±0.15	36.30±0.30	37.13*±0.14
Mule (G III)	36.64±0.17	37.60*±0.07	36.80±0.19	37.55±0.05	36.07±0.33	37.47*±0.15
Respiration rate min^{-1}						
Local donkey (GI)	23.45±1.33	26.95±1.15	25.10±1.14	28.65±1.18	22.20±0.80	26.80±2.63
Exotic donkey (GII)	24.881±1.44	25.55±1.06	23.66±1.49	46.25*±3.80	21.660±1.33	24.33±1.20
Mule (G III)	20.91±1.83	25.00±1.54	20.94±1.41	26.06±1.12	18.25±0.63	22.75±1.49

* ($P<0.05$) significantly higher than in morning session;
[a] ($P<0.05$) significantly higher than in afternoon session of pre-exposure period.

of concentrate @ 5 g kg^{-1} body weight and *ad libitum* chaffed sewan (*Lasiurus sindicus*) grass. Water was offered in the morning and afternoon after taking the physiological observations.

The experiment was conducted twice during hot dry season, i.e., July and August, over a period of 17 days. For the first 9 days, the animals were kept within covered portion of a shed during the day. This pre-exposure period was used as a control period. Thereafter, the animals were exposed to direct sun from 8.00 a.m. to 4.00 p.m. daily for six consecutive days and finally they were kept inside the shed for two days, and this post-exposure period was taken as the recovery period. Rectal temperature (RT) and respiration rate (RR) were recorded between 8.00 and 8.30 a.m. and between 4.00 and 4.30 p.m. on all the days of experiment. The mean minimum and maximum temperatures during the experiment were 27.64°C and 39.14°C, respectively. The mean relative humidity during the experiment was 68.47 and 43.26% at 7.00 a.m. and 2.00 p.m., respectively.

The data was statistically analysed (Snedecor and Cochran, 1968) to find out the breed and species differences and responses under shade and direct sun, using 't' test.

Results and Discussion

RR and RT recorded in the morning (M) during pre-exposure period of nine days were almost the same in all the three groups. However, afternoon (N) rectal temperature during this period increased significantly ($P<0.05$) in all the three groups of equids as compared to the morning values (Table 1). Similar trend was reported in ponies and donkeys when exposed to direct sun for a period of six days and for six hours (Pal *et al.*, 1998). Under range management and semi-arid condition, the diurnal increase

in RT of sheep and lamb has been observed to be 0.8 to 1.0°C (Karim and Patnayak, 1999).

Exposure to direct sun for eight hours and for six consecutive days caused significant ($P<0.05$) increase in the afternoon mean rectal temperature in all the three groups. The maximum increase in the afternoon rectal temperature on exposure to direct sun was observed in exotic (38.35±0.15°C) and indigenous donkeys (37.39±0.05°C) and these values were significantly ($P<0.05$) higher than their corresponding values during pre-exposure period in the afternoon session. In mules, RT also increased significantly in the afternoon session during heat exposure, but this increase was at par with the changes observed during pre-exposure period in afternoon session. Further, RT in the afternoon during heat exposure was significantly ($P<0.01$) higher in exotic donkeys than in local donkey and mule. This was possibly related to their dark/black color of hair. An increase in the core temperature of animals during exposure to direct solar radiation is well documented (Gupta and Acharya, 1987; Karim and Patnayak, 1999).

In this study, the forenoon RT during the periods of heat exposure to sun and during pre-exposure period was the same in all the three groups. This indicated that all the equids were able to get rid of the stored extra heat during the period of low temperature at night. Equids of all the three groups were able to bring down the forenoon and afternoon RT to pre-exposure levels within one day of post-exposure to direct sun, when they were kept in shed.

Respiration rate remained almost the same in mules, local and exotic donkeys during forenoon and afternoon sessions of pre-exposure period. However, respiratory frequency increased significantly ($P<0.01$) in exotic donkeys (Group I) during the period of exposure to direct sun as compared to the corresponding afternoon values of pre-exposure period. In the other two groups increase in RR during sun exposure was non-significant as compared to their corresponding afternoon values of pre-exposure period.

Donkeys are well adapted to and perform better in dry climatic conditions because of their remarkable thermal ability, superior muscle economy and reduced sweat rate (Yousef, 1990). In this study, significant increase in rectal temperature and respiration rate was observed in exotic black colored donkey than in the local grey/white colored donkey. This suggested that color imparted some thermolytic disadvantages to the exotic donkeys. It is concluded that compared to the local donkeys and mules, the exotic donkeys are least heat-tolerant on exposure to direct sun, as judged from the magnitude of increase in RT and RR in them. Mules are more heat-tolerant in comparison to the local donkeys.

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