

## A COMPARATIVE STUDY OF THE TURNOVER OF BODY WATER AND RESPONSES TO HEAT STRESS IN GRAZING RIVER AND SWAMP TYPE BUFFALOES

S.S.E. Ranawana, A.A.J. Rajaratne and N. Tilakaratne

Veterinary Research Institute, Gannoruwa, Peradeniya, Sri Lanka

### Introduction

From ancient times, indigenous swamp buffaloes have been used in Sri Lanka to provide farm power for activities connected with paddy cultivation. The Lanka buffalo is small in stature, has a low milk production but is otherwise well adapted to the environmental conditions prevailing in the country. For several decades past, imported Indian breeds of buffaloes such as Murrah and Surti have been used in cross breeding programmes in order to produce an animal that is heavier and stronger with a potential for a higher milk yield than the local buffalo. The adaptability of these Indian breeds or their crosses to conditions in Sri Lanka, particularly their ability to tolerate heat and humidity which reflects their ability to work, has not been studied. The objective of the present study was to compare the adaptability of Murrah and Surti with the Lanka buffalo under typical small-farmer conditions in the dry-zone of Sri Lanka. The adaptability was assessed by measuring several physiological parameters commonly accepted as indices of heat stress; since buffaloes have been shown to need more water than cattle (Ranawana et al., 1984) and since water is intimately associated with the mechanisms for heat loss, the daily turnover of body water was also measured.

### Materials and Methods

Five each of two-year old heifers of the Lanka, Murrah and Surti breeds were used in the study. They were grazed together on natural pasture during daylight hours, close to water, and paddocked in the night. No supplements were fed but buffaloes were free to graze or wallow as they wished. These conditions of management are similar to those practised by farmers in the dry-zone of Sri Lanka.

The dry-zone of Sri Lanka has a rainfall of upto

1,250 mm per year but except for some thunderstorm activity in April/May, most of the rain falls during the period October to December. As a result, this area experiences a long dry season. Although measurements were made for 12 months, for the purpose of this paper, only those for the dry period are presented.

The daily turnover of body water was measured in each animal over a period of two weeks in May. One mCi of tritiated water was injected intramuscularly and the specific activity of body water was measured in 6 blood samples drawn at intervals during the two weeks. Total body water (TBW) was calculated from the activity at time zero and the turnover from the fractional rate of decrease of activity. More details of the method are given in an earlier publication (Ranawana et al., 1983).

Rates of respiration, pulse and the skin and rectal temperature together with the cutaneous evaporation rate were measured in each animal at different times of the day on several days during the period May to September. Five sets of measurements were made early morning (between 06.00 and 06.45 hours) in order to obtain basal or resting values for these parameters. A further seven sets (on seven different days) were made at mid-day (11.00 to 11.45 hours) when the animals had been grazing for 3 to four hours in the sun. The methods used in these papers have been described in detail earlier (see Tilakaratne et al., 1983; Rajaratne et al., 1983).

Differences between breeds and the times of day were tested by analysis of variance.

### Results and Discussion

Sunny conditions with little wind prevailed on the days that the above measurements were made. Average values for ambient temperature and relative humidity recorded during the time the measurements were made are shown in table 1.

TABLE 1. AVERAGE VALUES FOR AMBIENT TEMPERATURE AND RELATIVE HUMIDITY

	Temperature (°C)	Relative humidity (%)
Early morning 06.00 to 06.45 h n=10	26.3±1.69	90±5.2
Midday 11.00 to 11.45 h n=14	34.0±0.87	57±3.3

Values for total body water (TBW) and daily turnover of body water (WTO) are shown in table 2. Murrah buffaloes had more body solids than the other breeds indicating that they carried more fat.

The turnover of body water when adjusted for differences in body weight and body water (ml/

kg<sup>0.82</sup>/day) was significantly lower in the Lanka buffalo. This is confirmed by the significant difference in the fractional rate of decline in activity. In general, the rates of turnover seen in this study are higher than in earlier measurements made in the midcountry and intermediate zone of Sri Lanka (Ranawana et al., 1984). This difference is due no doubt to the higher ambient temperature during this study and due to the fact that animals were grazing in the sun. However, the main observation from the present study is that the river buffaloes turnover more water than the Lanka animals.

Values for respiration and pulse rates and for skin and rectal temperature were not significantly different between breeds of buffaloes within each time of day. Average values for all animals were, therefore, calculated and are shown in table 3. The rates of cutaneous evaporation were, how-

TABLE 2. TOTAL BODY WATER (TBW) AND THE DAILY TURNOVER OF BODY (WTO) WATER IN LANKA, MURRAH AND SURTI BREED BUFFALOES. (EACH VALUE IS THE MEAN OF 5 MEASUREMENTS)

	Breed			P <
	Lanka	Murrah	Surti	
TBW				
(l)	116	128	126	NS
(% body weight)	66.7 <sup>ab</sup>	60.3 <sup>a</sup>	69.7 <sup>b</sup>	0.05
WTO				
(l/day)	34.3 <sup>a</sup>	41.7 <sup>b</sup>	39.6 <sup>ab</sup>	0.05
(ml/kg <sup>0.82</sup> /day)	498 <sup>a</sup>	517 <sup>ab</sup>	556 <sup>b</sup>	NS
(ml/kg <sup>0.82</sup> /day)	695 <sup>a</sup>	784 <sup>b</sup>	749 <sup>b</sup>	0.01
Fractional turnover (/day)	0.302 <sup>a</sup>	0.338 <sup>b</sup>	0.321 <sup>b</sup>	0.05

\* a, b, c Values with different superscripts are significantly different

TABLE 3. AVERAGE VALUES FOR RATES OF RESPIRATION AND PULSE AND FOR RECTAL AND SKIN TEMPERATURE IN ALL THREE BREEDS OF BUFFALOES

	Early morning* (n=75)	Midday* (n=103)	Increase (n=75)
Respirations (/min)	22.7±4.90	60.6±24.3	37.9
Pulse (/min)	53.6±6.36	71.8±8.62	18.2
Rectal temp. (°C)	38.04±0.43	39.91±0.72	1.87
Skin temp (°C)	31.8±1.67	37.6±1.31	5.8

\*Differences between values for morning and midday were statistically significant (P < 0.001)

TABLE 4. VALUES FOR CUTANEOUS EVAPORATION RATE IN LANKA, MURRAH AND SURTI BUFFALOES MEASURED EARLY MORNING AND AT MIDDAY (G/M<sup>2</sup>/MINUTE)

	Early morning	Midday	Increase
Lanka	332 <sup>a</sup>	479 <sup>a</sup>	147
Murrah	422 <sup>b</sup>	602 <sup>b</sup>	180
Surti	340 <sup>a</sup>	583 <sup>b</sup>	243
P <	0.01	0.001	

Values in the same column with different superscripts are significantly different at the level indicated

ever, different and these can be seen in table 4. The early morning values may be considered as basal or resting values. It can be seen that there were large increases in all the parameters measured, from these resting values to those at midday. The increases were, however, similar in all three breeds indicating that there is no difference between Lanka and the river breeds. These increases are also of the same order seen in similar studies in other parts of Sri Lanka (see Ranawana et al., 1984).

The relatively large increases in the rectal temperature of buffaloes has been recorded in earlier studies (Minett, 1947; Ranawana et al., 1984) and appears to be a characteristic of this species related to their ability to lose heat whilst wallowing. The rate of water loss from the skin is greater in the river breeds than in Lanka buffaloes.

The only differences seen in this study between Lanka and river type buffalo breeds Murrah and Surti were in their rates of water turnover and cutaneous evaporation. It is likely that these two are related, that the higher rate of turnover is due to a lesser ability to conserve water loss via the

skin. Apart from this higher water requirement in river buffaloes, they seem to be equally adaptable. It was concluded, therefore, that river type breeds such as Murrah and Surti are able to withstand the hot and humid conditions in Sri Lanka provided water is available freely for drinking and wallowing. They are, however, more likely to be affected by water shortages than Lanka swamp buffaloes. (Key Words: Buffalo, Water Turnover, Heat Stress)

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