

## Effect of seasonal variations on primary physiological responses of yak

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Yak, a multipurpose domesticated animal of high altitude mountainous terrain, has many characteristics which are regarded as adaptation to extreme cold and high solar radiations (Cai and Gerald 2003). Body temperature, pulse rate and respiration rate are three body responses considered as an index to the climatic conditions, shelter stresses and comforts (Blackshaw and Blackshaw 1994). Respiration rate is the most consistent of all the physiological responses studied, which is highly influenced by solar radiations. There is paucity of information on the effect of environmental conditions of yak. Hence, the present study was designed to determine the effect of seasonal variations on primary physiological responses in different age groups of yak.

The present study was carried out at the National Research Centre on Yak, located at 2750 m above mean sea level (msl) on 91°4' East longitude and 27° North latitude in Nyukmadung area of West Kameng district of Arunachal Pradesh, India. Healthy yaks (30) of different age groups and body weight were utilized in the present study. The animals were divided into 3 groups, viz. calves (8–12 months with body weight of 67.94±5.09 kg), adult bulls (3–5 years with body weight of 365.25±17.33 kg) and lactating yak cows (5–7 years with body weight of 265±10 kg), with ten animals in each group. They were maintained under semi-extensive system of management. The primary physiological responses of selected animals were recorded according to Sarkar *et al.* (2000) at fortnightly intervals during winter and summer. The average ambient temperature and relative humidity were 4.83±0.19°C and 76.54±1.32% during winter and 14.07±0.10°C and 89.61±1.04% during summer.

**Rectal temperature:** The results of average physiological responses are presented in Table 1. The rectal temperature was significantly ( $P<0.05$ ) higher during summer than winter in all 3 groups of yak. The rectal temperature of yak calves was significantly ( $P<0.05$ ) lower than adult bulls and lactating yak cows during winter. But it was significantly ( $P<0.05$ ) higher during summer compared to other groups. Present

results are in agreement with the findings of Sarkar *et al.* (2000) and Krishnan *et al.* (2008) in yaks. The rectal temperature of yaks was within the expected values during winter season at an altitude of 2750 m above msl with average ambient temperature of 4.83±0.19°C. During summer, the observed rectal temperature was significantly ( $P<0.05$ ) higher than winter. Prolonged exposure of yaks to increasing ambient temperature and relative humidity indicated poor compensatory heat loss mechanism of yaks to excessive heat load. It could be due to lesser number of functional sweat glands present in yak. The upper limit of ambient temperature at which yaks could maintain a stable body temperature is 10°C (Zhang 2000). If the ambient temperature exceeds beyond 10°C, rectal temperature started to rise from the expected value (99.68°F). The rectal temperature of yak calves were significantly ( $P<0.05$ ) lower during winter and higher during summer than adult yaks which might be attributed to higher thermal adaptability of adult yaks.

**Respiration rate:** Respiration rate (Table 1) was significantly ( $P<0.05$ ) higher during summer than winter in all 3 groups of yak. Respiration rate of yak calves were significantly ( $P<0.05$ ) lower than adult bulls and lactating yak cows during winter but it was significantly ( $P<0.05$ ) higher during summer. Present results corroborated with the findings of West (2003) in dairy cattle and Krishnan *et al.* (2009) in buffaloes. When yaks were exposed to fluctuating ambient temperature, the respiration rate increased significantly ( $P<0.05$ ) in response to heat stress during summer. The rise in respiration rate precedes rectal temperature and similar results were reported by Blackshaw and Blackshaw (1994) in cattle. An increase in respiration rate is an important thermoregulatory mechanism to heat stress and aids in heat dissipation through evaporative cooling (West 2003, Krishnan *et al.* 2009). When the ambient temperature is higher, the peripheral warm receptors are activated and they send neuronal signals to the warm receptors located in the anterior hypothalamus which stimulates increase in respiration rate to dissipate heat from the body.

**Pulse rate:** Pulse rate (Table 1) was significantly ( $P<0.05$ )

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Table 1. Average physiological responses of yak calves, adult bulls and lactating yak cows during winter and summer seasons (mean  $\pm$  SE)

| Physiological responses            | Group of animals   | Winter                          | Summer                          |
|------------------------------------|--------------------|---------------------------------|---------------------------------|
| Rectal temperature ( $^{\circ}$ F) | Calves             | 100.01 $\pm$ 0.01 <sup>Aa</sup> | 101.24 $\pm$ 0.10 <sup>Ba</sup> |
|                                    | Adult bulls        | 100.19 $\pm$ 0.02 <sup>Ab</sup> | 100.95 $\pm$ 0.08 <sup>Bb</sup> |
|                                    | Lactating yak cows | 100.12 $\pm$ 0.02 <sup>Ab</sup> | 101.00 $\pm$ 0.08 <sup>Bb</sup> |
| Respiration rate (Breaths/min)     | Calves             | 19.63 $\pm$ 0.11 <sup>Aa</sup>  | 29.26 $\pm$ 0.75 <sup>Ba</sup>  |
|                                    | Adult bulls        | 21.11 $\pm$ 0.15 <sup>Ab</sup>  | 27.08 $\pm$ 0.57 <sup>Bb</sup>  |
|                                    | Lactating yak cows | 20.92 $\pm$ 0.10 <sup>Ab</sup>  | 27.23 $\pm$ 0.60 <sup>Bb</sup>  |
| Pulse rate (Beats/min)             | Calves             | 58.41 $\pm$ 0.13 <sup>Aa</sup>  | 67.52 $\pm$ 0.68 <sup>Ba</sup>  |
|                                    | Adult bulls        | 60.29 $\pm$ 0.17 <sup>Ab</sup>  | 64.91 $\pm$ 0.54 <sup>Bb</sup>  |
|                                    | Lactating yak cows | 59.70 $\pm$ 0.14 <sup>Ab</sup>  | 66.34 $\pm$ 0.55 <sup>Bb</sup>  |

The means bearing different superscripts of capital letters are significantly ( $P < 0.05$ ) different in same row.

The means bearing different superscripts of small letters are significantly ( $P < 0.05$ ) different in the same column.

higher during summer than winter among different groups of yaks. The pulse rate of yak calves was significantly ( $P < 0.05$ ) lower than adult bulls and lactating yak cows during winter but it was significantly ( $P < 0.05$ ) higher during summer. The present results are in agreement with Collier *et al.* (2006) in cattle and Krishnan *et al.* (2009) in buffaloes. Pulse rate increased significantly ( $P < 0.05$ ) with increase in body temperature during summer. The increase in pulse rate indicated cardiac ability to fulfill increased demand of gas transport. This functional ability served as a heat loss mechanism by increasing blood flow to peripheral organs and skin taking away heat from core of the body.

It is concluded that at an altitude of 2750 m above msl, yaks generally experience heat stress during summer when ambient temperature exceeded  $10^{\circ}\text{C}$  and did not experience cold stress with an average ambient temperature of  $4.83 \pm 0.19^{\circ}\text{C}$  during winter.

### SUMMARY

A study was conducted to investigate effect of seasonal variations on different age groups of yaks. Thirty healthy yaks were divided into three groups viz., calves, adult bulls and lactating yak cows. They were maintained under semi-extensive system of management. The primary physiological responses viz. rectal temperature, respiration rate and pulse rate were recorded at fortnightly intervals during summer and winter in all the three groups. The physiological responses were significantly ( $P < 0.05$ ) higher during summer than winter in all the three groups. The physiological responses of calves were significantly ( $P < 0.05$ ) higher

than bulls and lactating yaks during summer and lower during winter. It is concluded from the physiological responses that yaks generally experience heat stress during summer but not cold stress during winter at 2750 m above mean sea level.

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